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SURVEY OF THE COLUMBIA RIVER AND ITS TRIBUTARIES - Part III

SPECIAL SCIENTIFIC REPORT: FISHERIES No. 36

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Explanatory Note

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Special Scientific Report - Fisheries

No. 36

SURVEY OF THE COLUMBIA RIVER AND ITS TRIBUTARIES

Part 3

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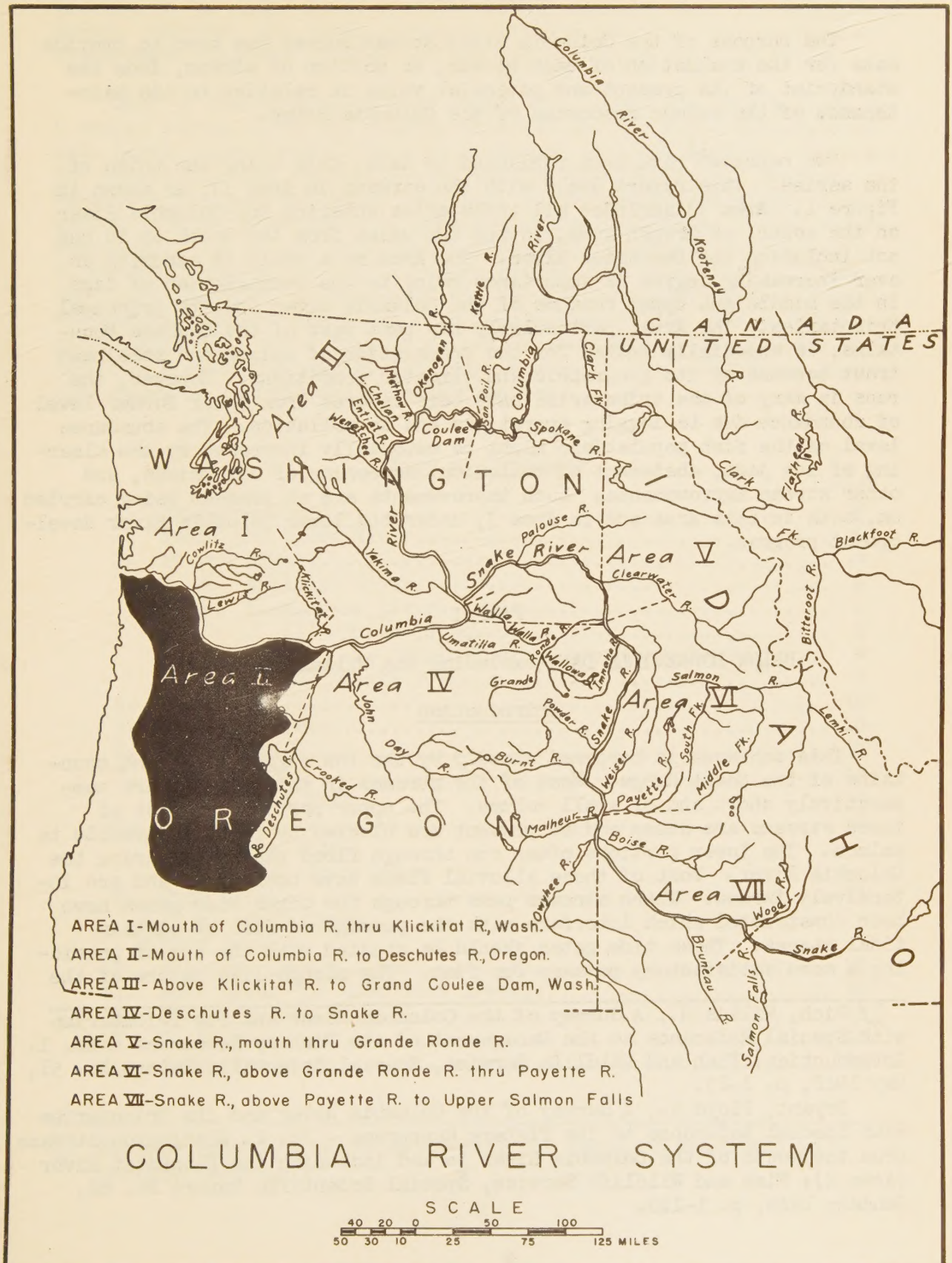

AREA I-Mouth of Columbia R. thru Klickitat R., Wash.
AREA II-Mouth of Columbia R. to Deschutes R., Oregon.
AREA III-Above Klickitat R. to Grand Coulee Dam, Wash.
AREA IV-Deschutes R. to Snake R.
AREA V-Snake R., mouth thru Grande Ronde R.
AREA VI-Snake R., above Grande Ronde R. thru Payette R.
AREA VII-Snake R., above Payette R. to Upper Salmon Falls

COLUMBIA RIVER SYSTEM

SCALE

40 20 0 50 100

50 30 10 25 75 125 MILES

Figure 1.-- Columbia River System

INTRODUCTION

The purpose of the Columbia River Stream Survey has been to provide data for the evaluation of each stream, or portion of stream, from the standpoint of its present and potential value in relation to the maintenance of the salmon resources of the Columbia River.

Two reports[1/] have been published to date, this being the third of the series. This report deals with the streams in Area II, as shown in Figure 1. Area II includes all tributaries entering the Columbia River on the south, or Oregon side, in the 204 miles from the mouth up to but not including the Deschutes River. The Area as a whole is assuming an ever increasing degree of importance owing to the construction of dams in the middle and upper reaches of the Columbia River and its principal tributaries. The Area, particularly the part west of the Cascade Mountains, is especially suited for the propagation of salmon and steelhead trout because of its geographic and climatic conditions. However, the runs in many of the tributaries have been reduced from their former level of abundance due to logging operations and to pollution. The abundance level of the fish populations might be materially increased by the clearing of log jams, abatement of pollution, screening of diversions, and other stream improvements. Such improvements are at present being carried on, both in this Area and in Area I, under the lower Columbia River development program.

PART I

BELOW BONNEVILLE DAM (excluding the Willamette River)

Introduction

This sub-area is bordered closely by the low rugged hills and mountains of the Coast Range. Most of the streams in this section are comparatively short and of small volume. The upper portions of most of these streams are steep and at present are blocked by falls impassable to salmon. The lower portions often run through flood plains bordering the Columbia River. Most of these alluvial flats have been diked and are intensively farmed. Where streams pass through the dikes tide gates have been constructed which interfere with the passage of fish at certain tidal stages. These tide gates should be studied with the aim of providing a more satisfactory passage for fish. The slough-like nature of the

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1/ Rich, Willis H., A Survey of the Columbia River and its Tributaries with Special Reference to the Management of its Fishery Resources - No. 1. Introduction: Fish and Wildlife Service, Special Scientific Report No. 51, May 1948, p. 1-25.

Bryant, Floyd G., A Survey of the Columbia River and its Tributaries with Special Reference to its Fishery Resources - No. 2. Washington Streams from the mouth of the Columbia River to and including the Klickitat River (Area I): Fish and Wildlife Service, Special Scientific Report No. 62, January 1949, p. 1-110.

streams in the tidal flats provides little spawning area for salmon and trout. However, the stream sections between the tidal flats and the steep upper sections usually include some suitable spawning areas.

Many of the watersheds were completely logged off long ago and as a result stream flows are usually much smaller and water temperatures much higher than formerly during the summer and fall months. Therefore, the stream spawning capacities are smaller than formerly. However, an extensive regrowth of timber and brush on the deforested slopes should result in some improvement of stream spawning conditions in the future. Practically all of the tributaries originally supported capacity runs of salmon, principally fall chinook, silver and chum salmon. There were also good runs of steelhead and sea-run cutthroat trout. Despite the harmful effects resulting from logging operations, the encroachment of civilization, and a certain amount of overfishing, the streams still maintain a sufficient nucleus of fish and still have sufficient potential value to warrant their rehabilitation.

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1/ Streams marked by an asterisk were too small or too steep to warrant survey.

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* North Side Boulder Creek
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* (1) Henry Creek
* (2) Still Creek
* (3) Camp Creek
* (4) Devil Canyon Creek
* (5) Lady Creek
* (6) Little Zigzag Creek

*Streams too small or too steep to warrant survey.

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The Survey

1. Skipanon River.--(April 14, 1938; Hanavan, Parkhurst, and Kolloen.) Enters the Columbia River 5 miles above the mouth at Warrenton, Oregon. It is 4 miles long, slough-like in nature, and has a flow of about 5 c.f.s. The lower portion of the stream is often polluted by waste products from fish rendering and processing plants. The stream is of no value to salmon.

2. Lewis and Clark River.--(April 13, 1938; Parkhurst and Kolloen. May 7-8, 1946; Zimmer, Fulton, Brewington, and Maltzeff.) Enters Youngs Bay 8 miles above the mouth of the Columbia River. The stream is 25 miles long, of which the lower 6 miles is a tidal slough of no value to spawning salmon. The stream was surveyed for a distance of 10½ miles above tidewater. In the section surveyed the stream was 10-30 feet wide, had a flow of 80 c.f.s., and the water temperature was 49 - 54° F., on May 8, 1946. The stream gradient is moderate in the lower section surveyed, increasing to fairly steep upstream.

The 7½ mile section from tidewater up to a deep canyon has low banks that are usually flooded each spring, and is bordered by pasture land and brushy slopes. Dense marginal vegetation affords some protection to fish along the entire stream course.

The canyon is approximately 1 mile long and the walls are so steep and the stream so deep that the survey party was unable to survey this section in detail.

The Warrenton domestic water supply dam, with an allotted diversion of 20 c.f.s., is located just above the canyon. The 1938 survey party found an impassable 35-foot high log dam at this point. This structure was later washed away and was replaced in 1946-47 by a new permanent structure that is provided with a fish ladder.

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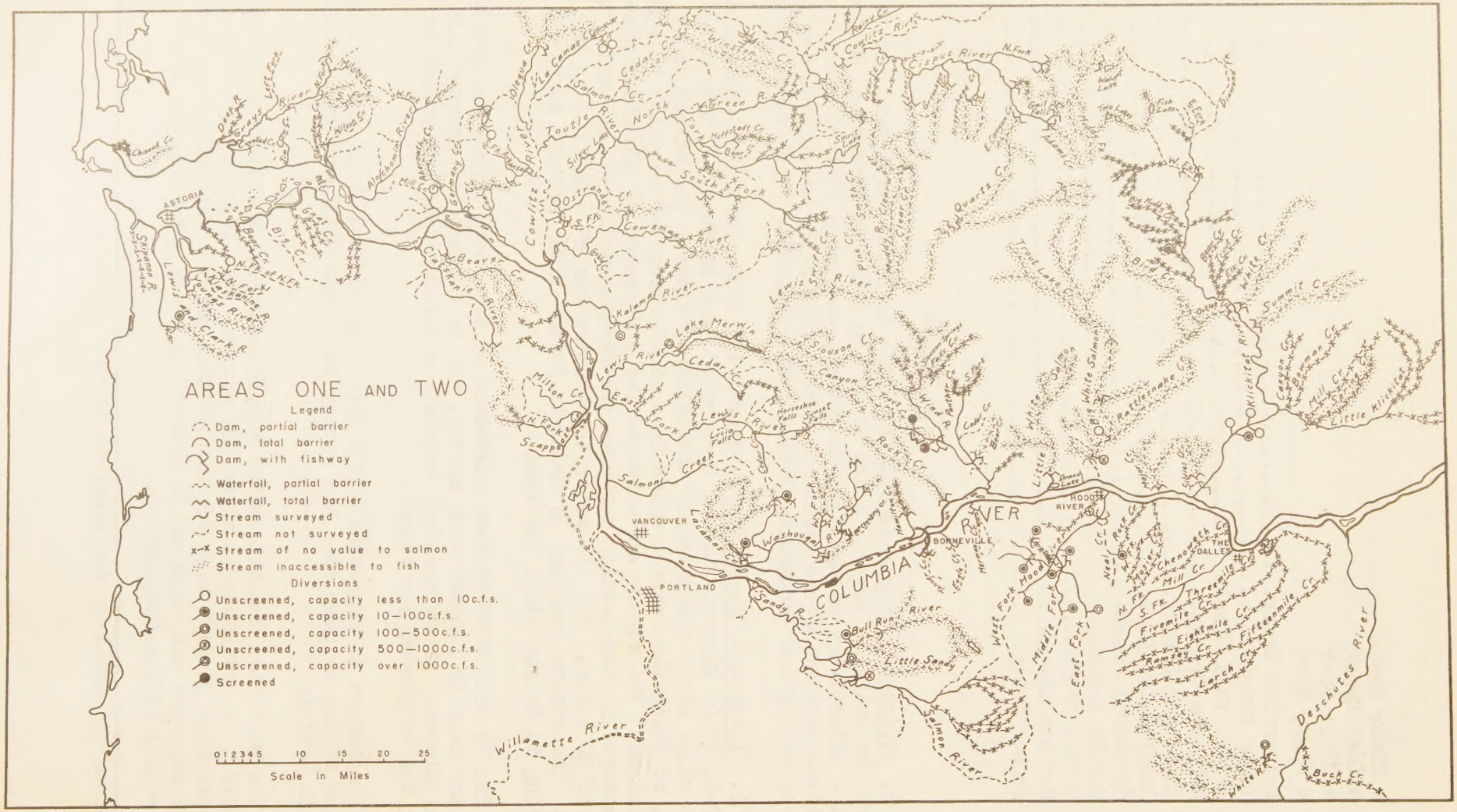
* Streams too small or too steep to warrant survey.


AREAS ONE AND TWO
Legend
Dam, partial barrier
Dam, total barrier
Dam, with fishway
Waterfall, partial barrier
Waterfall, total barrier
Stream surveyed
Stream not surveyed
Stream of no value to salmon
Stream inaccessible to fish
Diversions
Unscreened, capacity less than 10c.f.s.
Unscreened, capacity 10—100c.f.s.
Unscreened, capacity 100—500c.f.s.
Unscreened, capacity 500—1000c.f.s.
Unscreened, capacity over 1000c.f.s.
Screened
0 1 2 3 4 5 10 15 20 25
Scale in Miles
COLUMBIA RIVER
ASTORIA
PORTLAND
VANCOUVER
BONNEVILLE
HOOD RIVER
THE DALLES
Willamette River
Deschutes River
Lewis River
Cowlitz River
Toutle River
Kalama River
Salmon Creek
Washougal River
Sandy R.
Bull Run River
Little Sandy
Salmon River
White R.
Buck Cr.
Clackamas R.
Clatskanie River
Beaver Cr.
Milton Cr.
Scappoose Cr.
Lake Merwin
Yale Lake
Swift Reservoir
Lewis River
Cedar Cr.
East Fork
Lucia Falls
Horseshoe Falls
Spirit Falls
Siouxon Cr.
Canyon Cr.
Rock Cr.
Wind R.
Trout Lake Cr.
Big White Salmon
Little White Salmon
Rattlesnake Cr.
Klickitat River
Summit Cr.
Mill Cr.
Little Klickitat
Quartz Cr.
Big Muddy
Gail Falls
Trout Lake
Adams Cr.
Green R.
North Fork
South Fork
Hoffstadt Cr.
Berry Cr.
Spirit Lake
Silver Lake
Ostrander Cr.
Coweman River
Gully Cr.
Olequa Cr.
Ole Comas Cr.
Cedar Cr.
Wilson Cr.
Salmon Cr.
Coweeman River
Mill Cr.
Abernathy Cr.
Germany Cr.
Ft. Henry
Alpha
Delameter Cr.
Willow Cr.
Mitchell Cr.
Coal Cr.
Lacamas Cr.
Washougal River
Grays River
Deep R.
Chinook Cr.
Lewis & Clark R.
Lewis River
N. Fork of N.F.K.
Big Cr.
Bear Cr.
Grass Cr.
Shipman Cr.
Youngs Bay
Youngs River
Klaskanine R.
N. Fork
Scappoose
Milton Cr.
N. Fork
Lewis River
Cedar Cr.
East Fork
Lucia Falls
Horseshoe Falls
Spirit Falls
Siouxon Cr.
Canyon Cr.
Rock Cr.
Wind R.
Trout Lake Cr.
Big White Salmon
Little White Salmon
Rattlesnake Cr.
Klickitat River
Summit Cr.
Mill Cr.
Little Klickitat
Quartz Cr.
Big Muddy
Gail Falls
Trout Lake
Adams Cr.
Green R.
North Fork
South Fork
Hoffstadt Cr.
Berry Cr.
Spirit Lake
Silver Lake
Ostrander Cr.
Coweman River
Gully Cr.
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Ole Comas Cr.
Cedar Cr.
Wilson Cr.
Salmon Cr.
Coweeman River
Mill Cr.
Abernathy Cr.
Germany Cr.
Ft. Henry
Alpha
Delameter Cr.
Willow Cr.
Mitchell Cr.
Coal Cr.
Lacamas Cr.
Washougal River
Grays River
Deep R.
Chinook Cr.
Lewis & Clark R.
Lewis River
N. Fork of N.F.K.
Big Cr.
Bear Cr.
Grass Cr.
Shipman Cr.
Youngs Bay
Youngs River
Klaskanine R.
N. Fork
Scappoose
Milton Cr.
N. Fork
Lewis River
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East Fork
Lucia Falls
Horseshoe Falls
Spirit Falls
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Canyon Cr.
Rock Cr.
Wind R.
Trout Lake Cr.
Big White Salmon
Little White Salmon
Rattlesnake Cr.
Klickitat River
Summit Cr.
Mill Cr.
Little Klickitat
Quartz Cr.
Big Muddy
Gail Falls
Trout Lake
Adams Cr.
Green R.
North Fork
South Fork
Hoffstadt Cr.
Berry Cr.
Spirit Lake
Silver Lake
Ostrander Cr.
Cowee

There is approximately one mile of stream above the dam that is of value to migratory fish before the stream becomes too steep. Logging operations are nearly completed in the upper watershed, and several log jams were found, all of which were believed to be passable.

There is sufficient suitable spawning area below the dam for at least 2,000 pairs of salmon or steelhead trout, with the best spawning area located in the first 3 miles above tidewater. The 1946 survey party found a rock crusher removing gravel from the stream bed at a point 1½ miles above tidewater. There is spawning area above the dam sufficient for an additional 1,000 pairs of salmon or steelhead trout, provided that sufficient flow is maintained to permit fish to reach and ascend the fish ladder at all times.

Local residents report fair runs of silver and chum salmon and steelhead trout. Ten adult steelhead trout and 98 redds were observed by the 1946 survey party. Seven of these redds were located above the dam site. Carp were found in the lower slough section.

The only tributary of any possible importance enters in the canyon section and had a flow of 10 c.f.s. Since its stream bed is composed chiefly of bedrock and large rubble it is considered of little value to salmon.

3. Youngs River.--(May 2-3, 1946; Parkhurst, Zimmer, Brewington, and Maltzeff). Youngs River enters Youngs Bay about 10 miles above the mouth of the Columbia River. The stream is about 18 miles long, of which the lower 7 miles is a tidal slough of little value to spawning salmon, but may have considerable value as a rearing area for young salmon. The stream was surveyed for a distance of 3/4 mile from tidewater to the impassable Youngs River Falls, and was inspected at various points above the falls. The stream was 30-60 feet wide below the falls and had a flow of 107 c.f.s. The maximum discharge was 6,300 c.f.s. on November 24, 1927, and the minimum discharge was 3.7 c.f.s. on September 22-23, 1938 (U. S. Geological Survey Records). There is usually a discharge of 10-20 c.f.s. during the fall salmon spawning season. The water temperature was 56-58°F.

The only available salmon spawning area is located in the short section from tidewater up to the falls. Here there is a succession of excellent spawning riffles capable of supporting approximately 500 pairs of salmon. This area is utilized by fall runs of chinook, silver, and chum salmon and steelhead trout. There are also spring spawning runs of sea lampreys, suckers, and squawfish. Bass, catfish, crappie and other warm-water fish inhabit the lower slough area of the river.

Youngs River Falls is approximately 40 feet in height and drops abruptly over a rock ledge into a deep pool below. The section above the falls has a moderate gradient for several miles and extends through a rugged, logged-off hilly area. There is a large amount of spawning

area above the falls, particularly in the middle section of the stream, which is utilized by resident trout. The City of Astoria has a water right for 23 c.f.s. on this stream, and it is very possible that the city may construct a storage reservoir above the falls at some future date.

3A. Walluski River.--(May 9, 1946; Parkhurst, Gangmark, and Brewington). The Walluski River enters Youngs Bay about 3 miles above the Youngs Bay highway bridge. It is about 8 miles long, with a tidal slough comprising the lower 2½ miles. In the next 2½ miles the stream had an average width of 15 feet, a flow of 5 c.f.s., and the water temperature was 50°F. Although there is considerable mud and sand in the lower mile of this section, there is sufficient spawning area for at least 100 pairs of salmon. The upper section of the stream is small but contains some additional spawning area. Numerous log jams were found in this stream, some of which were believed to be impassable at low water stages. Local residents report that the available spawning area is well utilized by a run of chum salmon in November and early December. Large numbers of salmon fingerlings were observed.

3B. Klaskanine River.--(May 3, 1946; Parkhurst, Zimmer, Fulton, and Maltzeff). Enters Youngs River about 7 miles above the Youngs Bay highway bridge. The main stream extends for about 2 miles to the confluence of the North and South Forks. The lower 1½ miles is a tidal slough. The next 1/2 mile to a large, deep pool known as Smiley's Hole at the confluence of the forks contains spawning area for a few salmon. Silver and fall chinook salmon and steelhead trout comprise the principal runs entering the Klaskanine and its forks. A large spawning run of squawfish enters the river in the spring.

3B-(1). North Fork of the Klaskanine River.--(May 3-6, 1946; Parkhurst, Zimmer, Fulton, and Maltzeff). Enters the Klaskanine River about 2 miles above the mouth. The stream is about 13 miles long, of which 11 miles were surveyed. It was 18-40 feet wide, had a flow of 41 c.f.s. at the mouth and 30 c.f.s. at a point 7 miles upstream. The water temperature was 48-52° F. The stream gradient is moderate. From the mouth to the Oregon Fish Commission hatchery located about 2 miles upstream there are many good riffles with spawning area for at least 700 pairs of salmon. A 9-foot dam at the hatchery is provided with a fish ladder, but usually only a few spring steelhead trout are allowed to ascend the stream above this point, the salmon being taken for artificial propagation. Above the hatchery the stream runs through a narrow valley bordered by rugged hills covered with good stands of second growth timber. The marginal vegetation is fairly dense. At least 13 log jams were encountered, some of which probably are impassable at low water stages. Barth Falls, 5½ feet high, located 3.7 miles above the hatchery dam is a low water barrier.

The State hatchery formerly used Smiley's Hole at the mouth as a holding pool for fall-run salmon, and took practically all of the fish at racks just above this point for artificial propagation. It is reported that recently the majority of the fish have been taken at the hatchery. This change in procedure allows some of the fish to utilize the natural spawning area in the lower two miles. There is spawning area for at least 1,300 pairs of fish above the hatchery dam that is not being utilized at present.

There is an excellent run of silver salmon into this stream from which the hatchery usually takes 4 to 8 million eggs annually. There is also a run of fall chinook entering in September and October, and a few chum salmon have been reported. A small spring run of steelhead trout also enters the stream.

3B-(1)a. North Fork of the North Fork of the Klaskanine River.--(May 6, 1946; Gangmark and Brewington). Also known as the Little North Fork of the Klaskanine River. Enters the North Fork just above the hatchery dam. It is approximately 6 miles long of which 3.6 miles were surveyed. The stream was 9-30 feet wide, had a flow of 10 c.f.s., and the water temperature was 48-52° F. The gradient is moderate to fairly steep. The stream drains a narrow, brush-choked valley.

At the time of the survey there were two small dams, located 237 and 900 yards above the mouth, for the diversion of auxiliary water to the fish hatchery on the North Fork. The lower one was not in operation, and the upper dam was diverting 2 c.f.s. These dams are provided with stationary trash racks and are barriers to fish. There are more than 25 log jams and at least 12 beaver dams that are either low-water or total barriers to salmon in the section surveyed. Improvements on this stream are not recommended unless salmon are allowed to pass the hatchery dam on the North Fork.

3B-(2). South Fork of the Klaskanine River.--(May 7-8, 1946; Parkhurst, Brewington, Gangmark, and Maltzeff). Enters the Klaskanine River about 2 miles above the mouth. The stream is approximately 15 miles long, of which the lower 10½ miles were surveyed. It was 50 feet wide at the mouth, and was discharging 45 c.f.s. The water temperature ranged from 48° to 51° F. The gradient is moderate over most of the course, increasing to steep in the upper section. There is a large amount of excellent spawning area, estimated sufficient to accommodate at least 5,000 salmon in the lower 6¼ miles up to an impassable falls 20 feet high. There is potential spawning area for an estimated 1,000 additional fish above the falls.

At the time of the survey the stream was blocked at the mouth by an Oregon State hatchery rack. It is understood that this rack is now installed only during the hatchery spawn taking period in the fall. There are numerous log jams in the stream, several of which were considered to be passable only at high water stages and should be removed.

In addition to the impassable waterfall noted above there are several other falls passable to salmon and trout with more or less difficulty, depending on the water stage. There is an 8-foot falls located about 5 miles above the mouth. Another dog-leg falls 6 feet in height is located 300 yards farther upstream.

There is an 8-foot falls located 8½ miles above the mouth that is a barrier at low water. These falls could easily be improved for the passage of fish.

A portion of the chinook and silver salmon that enter the Klaskanine River undoubtedly would ascend the South Fork if they were allowed to pass the hatchery rack at the mouth. Larger numbers of steelhead trout will undoubtedly use this stream now that the hatchery rack is in place only during the fall. At the time of the survey the rack was passable only when flooded at extremely high water stages, and only a few steelhead were able to ascend, 12 adults and 16 redds having been observed. Thousand of squawfish (Ptychocheilus oregonensis) locally called suckers, ascend the stream in the spring to spawn.

4. Mill Creek.--(May 16, 1946; Zimmer). This small stream enters the Columbia River about 14 miles above the mouth, just above Astoria, Oregon. It is about 2 miles long of which 1.6 miles were surveyed. The stream was discharging about 10 c.f.s. The stream bed contains a large percentage of mud and sand, but there is spawning area for at least 100 pairs of salmon. There are several beaver dams which may be barriers at low water. A small late fall run of salmon was reported, but the species was not determined. Salmon fry were abundant throughout. The stream seems to be best adapted to chum salmon.

5. John Day River.--(May 16, 1946; Fulton, Gangmark, and Brewington). Enters the Columbia River about 15 miles above the mouth, and should not be confused with the much larger John Day River that enters the middle section of the Columbia River above Bonneville Dam. The stream is about 7 miles long of which the lower 3 miles is a tidal slough. About 1/2 mile below the upper end of the slough the channel is crossed by an earth dike equipped with a tide gate. There are several small spring-fed branches above the slough area that contain a very small amount of spawning area. A few chum salmon have been reported in the stream.

6. Mary's Creek.--(June 11, 1942; Parkhurst). Enters the Columbia River about 19 miles above the mouth through Svenson Slough. It is a small, mud-bottom stream less than 2 miles in length, and is of no value. The estimated discharge was less than 2 c.f.s.

7. Bear Creek.--(October 18, 1945; Johanson). Enters the Columbia River about 19 miles above the mouth through Svenson Slough. The stream

is approximately 6 miles long, of which the lower mile is a tidal slough. It was surveyed up to a falls 6 feet in height located about 3¼ miles above the mouth, and which is a barrier at low water. The stream was 15 feet wide and was discharging only 1 c.f.s. The gradient is mostly moderate. There is spawning area below the falls for about 200 pairs of salmon. A few small log jams and beaver dams were found in the section surveyed. These are probably passable at high water. An impassable 50 foot high reservoir dam and diversion for the City of Astoria domestic water supply is located about 5 miles above the mouth. The only tributary of any value is Little Bear Creek, entering about 1½ miles above the mouth and discharging about 1/2 c.f.s. The stream bed above the confluence of Little Bear Creek was practically dry at the time of observation. It was reported that small runs of silver and chum salmon enter the stream late in the fall when the flow is considerably higher. The stream is probably passable up to the Astoria water supply dam at high water stages.

8. Big Creek.--(August 1, 1944 and October 17, 1945; Bryant, Brewington, Davis, and Johanson). Enters the Columbia River about 23 miles above the mouth through Knappa Slough. The stream is approximately 13 miles long, of which the lower 1/2 mile is a tidal slough. It was surveyed for a distance of 9½ miles above the mouth. The stream was about 40 feet wide, and was discharging 11 c.f.s. at a low-water stage. The water temperature was 45-48° F., and the stream gradient is moderate.

An Oregon State Fish Commission hatchery is located 3 miles above the mouth, and the hatchery racks block the stream at this point. Temporary racks also are installed just above tidewater 1/2 mile above the mouth during the fall season. There is suitable spawning area for at least 1,000 fish below the hatchery and 2,500 above. A few steelhead pass above the hatchery racks during the spring high water period. The stream has fair hatchery runs of fall chinook, chum salmon, and steelhead trout, and a good run of silver salmon.

9. Gnat Creek.--(or Knapp's Creek): (Inspected May 9, 1946; Parkhurst, Zimmer, Maltzeff, and Fulton). Enters the Columbia via Blind Slough above Knappa, Oregon, and is about 9 miles long. It had a flow of about 30 c.f.s. and the water temperature was 49° F. The gradient is moderate to fairly steep, and there is a preponderance of bedrock and large rubble providing little suitable spawning area.

10. Plympton Creek.--(October 15, 1945; Parkhurst, Brewington, Davis, and Johanson). Enters the Columbia via Westport Slough at Westport, Oregon, and is about 6 miles long. The stream was about 15 feet wide, discharging 5 c.f.s., and the water temperature was 48-52°F. The lower 1/2 mile is badly polluted by sawmill waste and sewage from the town of Westport.

A diversion dam 5 feet in height is located 1/3 mile above the mouth. It has a fair fishway, and the diversion of 1-2 c.f.s. is screened.

The Westport water supply diversion dam is 4 feet in height and is located 1 mile above the mouth. The diversion of 1.5 c.f.s. is screened. The dam is difficult for fish to pass during low water periods.

There are two impassable waterfalls 8 feet and 6 feet high located 1½ miles above the mouth. A series of 3 additional waterfalls 8, 30, and 15 feet high are located 300 yards farther upstream, and other barriers, including an abandoned 30 foot high dam, exist above.

Spawning area for a few salmon occurs in the lower 1½ miles. The obstructions and steep gradient above this point render the remainder of the stream inaccessible to migratory fish. A few salmon, presumably silvers and chums, enter in the fall, but are reported to be greatly molested by some persons in Westport. The only improvement warranted on this stream would be the elimination of pollution in the lower section.

11. West Creek.--(or Dave West Creek)

12. Oleson Creek.--

13. O. K. Creek.--

14. Tandy Creek.--(Inspected June 11, 1942; Parkhurst). These are all small streams discharging less than 5 c.f.s. and entering the Columbia within 5 miles above Westport, Oregon. Because of their small size and general absence of suitable spawning areas none are of value to salmon.

15. Clatskanie River.--(October 11, 1945; Parkhurst, Brewington, Davis, and Johanson). Enters the Columbia at Clatskanie, Oregon, and is about 25 miles long, of which 12 miles were surveyed from tidewater to an impassable waterfall 7 feet in height. The stream was 15-18 feet wide (at low water stage) and discharging 5 c.f.s. The water temperature was 50-55° F.

The lower 1½ miles are slough-like; the succeeding 8 miles upstream contain suitable spawning areas, followed by a 3 mile section up to Clatskanie Falls having a steeper gradient and little suitable spawning area.

There were 9 beaver dams and 3 log jams that were difficult or impassable to fish at low water stages.

Clatskanie Falls at the upper terminus of the survey is 8 feet high and formerly was impassable to fish except at high water. Recently a passage was blasted through one side of the falls by the Oregon Fish Commission. The Oregon Commission is also improving the lower section of the stream for the passage of fish.

There is spawning area for several hundred salmon below the first log jam, and for about 2,000 more fish up to the falls. Although no salmon were observed, local residents report small runs of fall chinook, silver, and chum salmon and steelhead trout.

Three small tributaries, Fall, Conyers, and Carcus Creeks, had flows of 2 c.f.s., but are of little value to salmon.

15A. Beaver Creek.--(May 13, 1946; Parkhurst, Brewington, Gangmark, and Fulton). Beaver Creek enters the lower slough-like portion of the Clatskanie River at a point 1½ miles above the Columbia, opposite the upper end of Wallace Island. The stream is 16 miles long, of which the lower 2½ miles are tidal slough, and was surveyed for a distance of 3.7 miles above tidewater.

The stream was 15-30 feet wide, and was discharging 10 c.f.s. The water temperature was 52-59° F. There is spawning area for several hundred salmon in the first 3 miles above tidewater to an impassable falls 40 feet in height. The stream was surveyed for a distance of 3/4 mile above the falls, in which there is a steeper gradient and the stream bed consists mainly of bedrock and boulders. At a point 5 miles above tidewater two falls, 10 feet and 6 feet in height, and two bad log jams were found. Numerous silver and chum salmon fingerlings were seen below the lower 40 foot falls. A winter run of steelhead trout and a fall run of sea-run cutthroat trout were reported.

15A-(1). South Fork, Beaver Creek.--(June 10, 1942; Parkhurst). Enters Beaver Creek above Beaver Creek Falls, and is not accessible to migratory fish. It is a small stream, of little value to fish.

16. Goble Creek.--

17. Tide Creek.--(May 14, 1946; Parkhurst, Zimmer, and Brewington). Both streams enter the Columbia just below Deer Island. They are 7-10 miles long and carry little water during the summer. Impassable falls 10-12 feet in height are located about 1/2 miles above the mouth of each. The water temperature was 50-52° F., and both streams were discharging 20-25 c.f.s.

Both streams have spawning area for a few fish below the falls and small additional amounts above. A few steelhead trout and chum salmon are reported to ascend to the falls on Goble Creek during the higher water stages in late fall, but tide gates prevent the entrance of any migratory fish into Tide Creek.

18. Milton Creek.—(May 14-15, 1946; Parkhurst, Fulton, and Gangmark). Enters the Columbia via the Willamette Slough at St. Helens, Oregon. The stream is about 20 miles long, of which the lower 7.2 miles were surveyed. The stream was 18-30 feet wide, discharging 18 c.f.s., and the water temperature was 53° F.

Between 5 and 6 miles above the mouth there is a 3 ft. high concrete dam and two cascades, one of which is believed to be a low water barrier. A diversion in the headwaters provides the water supply for the town of St. Helens, and greatly reduces the normal stream flow. Sewage and other pollution was noted in the lower section of the stream. There is spawning area for about 1,000 fish in the section surveyed. Numerous fingerlings, believed to be mostly silvers and some chum salmon, were observed. Several steelhead redds also were seen.

19. McNulty Creek.—(Inspected May 15, 1946; Parkhurst, Zimmer, and Brewington). Enters the Columbia via Willamette Slough near the town of Warren, Oregon. It is about 7 miles long and was discharging 5 c.f.s., but is reported to become dry at times during the summer. There is little suitable spawning area and the stream is of no value to salmon.

20. Scappoose Creek.—(October 8, 1945; Parkhurst and Brewington). Enters the Columbia River via Willamette Slough near the town of Warren, Oregon. The main stream is about 6 miles long, of which the lower 4 miles is tidal slough of no value as a spawning area. The 2 mile section from tidewater to the confluence of the north and south forks was surveyed. In this section the stream was 15-21 feet wide, had a flow of 10 c.f.s., and the water temperature was 60° F. The gradient is slight and there is suitable spawning area for about 200 salmon. There is some silting of spawning beds due to bank erosion. Between 60 and 70 spawning fall chinook salmon were observed. Several log jams and beaver dams may be barriers to fish at low water, and should be removed.

20A. North Fork, Scappoose Creek.—(October 8, 1945; Parkhurst, Davis, and Johanson). The stream is 10 miles long, of which the lower 5 miles were surveyed to an impassable waterfall 18-20 feet in height. The stream was 7-12 feet wide, discharging 5 c.f.s., and the water temperature was 58° F. The gradient is slight to moderate. The stream bed in the surveyed section contains 6,200 sq. yd. of suitable spawning area, sufficient to accommodate more than 600 fish. There also is an undetermined amount of spawning area above the falls.

There were numerous log jams and beaver dams in the stream, some of which were barriers to the migration of salmon.

No salmon were observed in the North Fork, possibly due to a bad log jam 200 yards above the mouth. Fall chinook, silver salmon, and a few steelhead were reported up to the falls in past years.

The stream should be made passable to migratory fish and the value of a fishway over the falls should be determined.

20A-(1). Left Fork of North Fork Scappoose Creek.--(June 10, 1942; Parkhurst). Enters the North Fork 4.2 miles above Scappoose Falls, and therefore is inaccessible to migratory fish. It is a small, spring-fed stream, discharging 2 c.f.s., and had a water temperature of 50° F. The stream contains excellent spawning areas, and is heavily populated with small trout. It appears to be of some potential value for the spawning and rearing of a small number of salmon and steelhead.

20B. South Fork, Scappoose Creek.--(October 8-9, 1945; Parkhurst, Brewington, Davis, and Johanson). The stream is 14 miles long, of which 7 miles were surveyed. It was 7-14 feet wide, discharging 5 c.f.s., and the water temperature was 55° - 57° F. The lower 3 miles consists of slough area, with a slight gradient and no suitable spawning area. In the next 4 miles surveyed upstream the gradient becomes moderate, and there are more than 10,000 square yards of excellent spawning area, sufficient to accommodate approximately 1,000 salmon.

Numerous log and debris jams were found especially in the lower section. Many of these obstructions appeared to be impassable to fish at low water stages, and should be removed.

No salmon were observed, although a small run of silvers was reported. The stream could support small runs of fall chinook, silver, and chum salmon, as well as steelhead trout.

21. Willamette River.--(See Part II Sub-Area Willamette).

22. Sandy River.--[1/] (March 15-20, 1940; Hanavan and Parkhurst). Enters the Columbia River about 18 miles upstream from Portland, Oregon. The Sandy is about 45 miles long, most of which was surveyed. The discharge at the mouth was estimated to be about 2,000 c.f.s. at the time of observation. However, the recorded discharge ranges from a maximum of 58,000 c.f.s. to a minimum of 53 c.f.s. (U.S.G.S. records). The gradient is slight in the lower 2 miles, becoming generally moderate, and increasing to steep in the upper section above the confluence of the Zigzag River on the lower slopes of Mt. Hood.

Marmot Dam, owned and operated by the Portland General Electric Company, is the only obstruction to fish on the main stream. This dam is located 27 miles above the mouth, and is 30 feet in height. It diverts water from the Sandy River into a flume and tunnel which empties into the Little Sandy River immediately above another dam. The combined flow of the Marmot and Little Sandy diversions is then carried by another

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1/ Craig and Suomela, A Survey of the Sandy River and its Tributaries, 1940, with Reference to Fish Management: U. S. Fish and Wildlife Service: Special Scientific Report No. 14.

Figure 3.-- Salmon River, a tributary of the Big Sandy River; suitable salmon spawning area.

flume into a reservoir from which it discharges through a power house into the Bull Run River at a point about 1½ miles above the mouth of the latter. The power house contains 4 high-speed turbines operating under a 320 foot head. Both the Marmot and Little Sandy diversions are unscreened. However, the Oregon Fish Commission is negotiating with the Portland General Electric Company for the installation of a rotary screen on the Marmot Dam diversion. At any time of the year a large portion of both streams is diverted and during the summer months the entire flows are usually taken except for the small amount allowed to pass down a fish ladder at Marmot Dam. It necessarily follows that the great majority of downstream migrants from above these dams are killed by passage through the powerhouse. During low water stages there is no spill over these diversion dams, and on the main Sandy there is often an 11 mile dry section from the confluence of the Bull Run River to Marmot Dam. In order to allow migratory fish to successfully utilize the extensive spawning areas above Marmot Dam it would be necessary to maintain an adequate flow in this stream section.

There is a large amount of spawning area in the Sandy River, and the stream formerly supported large salmon runs. However, the difficulties imposed by the Marmot Dam and diversion, and the extreme fluctuation in flow below the dam render it difficult to determine the amount of spawning area actually available to salmon. Under present conditions it is probable that the low flow conditions below the dam would render the stream of little value for the natural spawning of fall chinook and silver salmon.

The Oregon Fish Commission operates a hatchery at the dam and places racks across the stream at a point about 1/2 mile above the dam where eggs are taken for artificial propagation. Spring chinook, silver salmon, and steelhead trout are propagated at this station. Some steelhead are taken for the hatchery in traps placed in the fishway at Marmot Dam.

Large runs of smelt enter the lower section of the river in most years to spawn and they support extensive commercial and sport fisheries.

Channel improvements on the lower river have greatly aided the entry of migratory fish into the stream. The Sandy formerly entered the Columbia through two mouths, known as the Big Sandy and Little Sandy channels. The Oregon Game Commission dammed the Big Sandy channel in 1938, concentrating the entire river flow in the Little Sandy channel. Additional work on the dam was done by the Federal Government in 1940, and at that time extensive bank-protective works were installed.

22A. Gordon Creek.--(Inspected March 15-20, 1940; Hanavan and Parkhurst). Enters the Sandy River about 11 miles above the mouth. It is the largest of the minor tributaries and maintains a fair summer flow when other small tributaries are nearly dry. The discharge at the time of observation was about 45 c.f.s. The stream contains some good spawning area, but was not surveyed in detail. Several liberations of fall chinook salmon fingerlings have been made into Gordon Creek from the U. S. Fisheries Station at Underwood, Washington.

22B. Trapper Creek.--

22C. Trout Creek.--(Inspected March 15-20, 1940; Hanavan and Parkhurst) These two streams enter the Sandy River near Gordon Creek. Both reach very low water stages in summer, and therefore are of little or no value to salmon.

22D. Bull Run River.--(March 15-20, 1940; Hanavan and Parkhurst). Enters the Sandy River about 16 miles above the mouth. The stream is about 25 miles long, of which the lower 11 miles were surveyed up to the Portland domestic water storage dam. In the lower section the river was 100-150 feet wide. The discharge varies widely due to diversion demands.

The Bull Run power plant of the Portland General Electric Company is located 1½ miles above the mouth.

The Municipal Water Department of the City of Portland operates a diversion dam 40 feet in height located 6 miles above the mouth. This dam forms the upstream limit of fish migration.

Five miles farther upstream there is located the high storage dam of the Portland Municipal Water Department.

The stream gradient is fairly steep, and contains comparatively little spawning area. It is estimated that the 6 mile section up to the diversion dam might accommodate 2,500 fish. A few silver salmon and steelhead trout spawn in this section. There is a possible hatchery site in this section for the propagation of fall chinook, silver salmon, and steelhead trout. Because of the nature of the stream bed the 5 mile stream section from the diversion dam to the high storage dam is of little potential value to migratory fish. The area above the storage dam is of no possible value to migratory fish.

22D-(1). Little Sandy River.--(March 15-20, 1940; Hanavan and Parkhurst). Enters the Bull Run River about 3 miles above the mouth. The stream is about 12 miles long, of which the lower 1½ miles was surveyed, up to an impassable power diversion dam 15 feet high.

It is only during brief freshet periods that water flows in the stream channel below this dam. All normal flows are diverted to the Bull Run powerhouse (see above number 22). For this reason the stream is of no present or potential value to migratory fish.

22E. Cedar Creek.—

22F. Badger Creek.—(March 15-20, 1940; Hanavan and Parkhurst). These two streams both enter the Sandy River below Marmot Dam in the section that usually becomes dry in summer because of the Marmot diversion. They are small streams with low summer flows, and are of no importance.

22G. Salmon River.—(March 15-20, 1940; Hanavan and Parkhurst). Enters the Sandy River about 35 miles above the mouth. It is about 32 miles long, of which the lower 7 miles were surveyed. It was 90-150 feet wide in the lower section, although it has considerable fluctuation in size. During the fall spawning season (September-November) the discharge at the mouth usually ranges from 70 to 200 c.f.s.

Although the stream heads in a glacier on Mt. Hood, the greater part of its flow comes from springs, and it is consequently less affected by silt and sand than the main Sandy and Zigzag Rivers. Extensive spawning areas were found in the section surveyed. The Salmon River is said to have formerly supported the largest runs of spring chinook, silver salmon, and steelhead trout in the Sandy River system. The former U. S. Bureau of Fisheries and the Oregon Fish Commission operated an egg-taking station on this stream from 1896 to 1913. Few salmon now reach the stream, due to the effects of the Marmot Dam and diversion. The potential value of the Salmon River to migratory fish is entirely dependent on the solution of the problems affecting fish at the Marmot Dam and diversion.

22H. Zigzag River.—(March 15-20, 1940; Hanavan and Parkhurst). Enters the Sandy River 40 miles above the mouth. The stream is about 14 miles long, of which the lower mile was surveyed. Above this point the stream is too steep to be of much possible value to fish. The stream was 40-75 feet wide, fairly steep and carried a large amount of glacial silt. The lower 400 yards is channeled for flood control. Spawning area is found only in small scattered patches. The stream is of little present value to migratory fish because of conditions at the Marmot Dam and diversion on the main Sandy River. Several small tributaries are utilized to a small extent by steelhead trout.

Four small tributaries to the upper Sandy River have small patches of spawning area but are generally inaccessible to salmon. A few steelhead have been reported in Clear Creek.

23. Latourelle Creek.—

24. Young Creek.—

TABLE OF OBSTRUCTIONS AND DIVERSIONS 1/

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Diversion in c.f.s.	Existing Protective Devices	Recommendations
Lewis and Clark River	Warrenton water supply dam	35	20	Fishway	None
Youngs River	Falls	40	--	None	None at present
Walluski River	Log jams	Low	--	None	Remove
N.Fork, Klaskanine R.	Hatchery dam	9	--	Fishway	None
	Log jams	Low	--	None	Remove
	Barth Falls	5½	--	None	See Text
N.Fork of N. Fork, Klaskanine R.	2 hatchery dams	Low	2	None	See Text
	25 log jams and 12 beaver dams	Low	--	None	See Text
Mill Creek	Beaver dams	Low	--	None	Breach at spawning time
John Day River	Tide gate	--	--	None	Study
Bear Creek	Falls	6		None	Fishway
	Astoria water supply dam	50	varied	None	None

1/ This list does not include minor cascades, low falls, log and brush jams, etc., that do not interfere with passage of migratory fish. The listed height of falls and dams is the approximate height that fish would have to jump to clear the obstruction at normal water levels; i.e. the distance from tailwater to the crest of the obstruction. Small irrigation pumps are usually screened and are not listed in the table of diversions.

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Diversion in c.f.s.	Existing Protective Devices	Recommendations
Big Creek	Hatchery racks	—	--	None	—
Plympton Creek	Mill dam	5	1-2	Fishway;screen	None
	Westport water supply dam	4	1.5	Screen	None
	5 Falls	8,6,8, 30,15		None	None
	Abandoned dam	30	--	None	None
Clatskanie	Falls	7	--	None	Fishway
	3 log jams; 9 beaver dams	Low	--	None	Remove; breach at spawning time
Beaver Creek	3 Falls	40,10,6	--	None	None
Goble Creek	Falls	12		None	None
Tide Creek	Tidegate	--		None	Study
	Falls	12	--	None	None
Milton Creek	Dam	3	--	None	Study
	Cascade	6	--	--	Study
	St. Helens water supply diversion	--	varied	None	None
Scappoose Creek	Log jams and beaver dams	Low	--	None	Remove

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Diversion in c.f.s.	Existing Protective Devices	Recommendations
N. Fork, Scappoose Creek	Log jams; beaver dams	4-10	--	None	Remove
	Falls	18-20	--	None	Study
S.Fork,Scappoose Creek	Log jams	Low	--	None	Remove
Sandy River	Marmot dam	30	600 (often entire flow)	Fishway	Screen; channel below dam (see text)
	Hatchery racks	--	--	None	None
Bull Run River	Portland water supply dam	40	60-100	None	None
	Storage dam	High	--	None	None
Little Sandy River	Power dam	15	100 (usually entire flow)	None	None
Latourell Creek	Falls	High	--	None	None
Sheppards Dell Creek	Falls	High	--	None	None
Bridal Veil Creek	Falls	High	--	None	None
Wahkeena Creek	Falls	High	--	None	None

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Diversion in c.f.s.	Existing Protective Devices	Recommendations
Multnomah Creek	Falls	High	--	None	None
Oneonta Creek	Falls	High	--	None	None
Horsetail Creek	Falls	High	--	None	None
Tumalt Creek	Falls	High	--	None	None
McCord Creek	Falls	High	--	None	None
Moffett Creek	Falls	High	--	None	None
Tanner Creek	Hatchery racks	--	--	--	None
	Falls	100	--	None	None

25. Bridal Veil Creek.--

26. Wahkeena Creek.--

27. Multnomah Creek.--

28. Oneonta Creek.--

29. Horsetail Creek.--

30. Tumult Creek.--

31. McCord Creek.--

32. Moffett Creek.--(Inspected March 21, 1944; Nielson).

These small streams enter the Columbia in the 15 mile section below Bonneville Dam. All of them are blocked by high and often picturesque natural falls at or near their mouth, and are therefore of negligible value to salmon.

33. Tanner Creek.--(Inspected March 21, 1944; Nielson). Enters the Columbia River immediately below Bonneville Dam and extends for 4 miles to the confluence of its two forks. It is blocked by a falls over 100 feet high about 1 mile above the mouth. The stream was discharging about 15 c.f.s. Suitable spawning area constitutes about 20 percent of the total stream bottom below the falls, but is little utilized by the fall run of chinook salmon that enters the stream, since these fish are intercepted by the Oregon Fish Commission in connection with the operation of its Bonneville Hatchery, which is located on this stream.

PART II

WILLAMETTE RIVER SYSTEM

Introduction

The Willamette River is the largest tributary to the Columbia below the Snake River. It has a drainage basin of about 12,000 square miles. The watershed is bounded on the east by the rugged Cascade Mountains having an average elevation of 4,000 - 7,000 feet, with a number of snow-capped peaks rising to heights of 9,000 - 11,000 feet. On the west the basin is bounded by the lower and more rolling Coast Range with a general elevation of 1,000 - 2,000 feet and occasional peaks up to 4,000 feet. On the south the Willamette is separated from the northern California drainage by the Siskiyou Mountains.

The Willamette Valley is a highly productive agricultural area approximately 200 miles long and 20-40 miles wide. Since the valley has a very slight gradient, it always has been subject to flood and drainage problems. The Cascade Mountains particularly intercept moisture laden air masses brought by prevailing westerly winds from the Pacific Ocean, causing heavy rainfall in the spring and fall months and heavy snowfall in the winter months on the western slopes of these mountains.

The Willamette River has an extensive tributary system. Because of their larger size and sustained flows, the tributaries originating in the Cascades are more important to migratory fish and many of them formerly supported very large runs of salmon and steelhead trout.

The streams entering the Willamette from the Coast Range apparently never have been of any great importance to migratory fish. The fall chinook run apparently never passed above Willamette Falls, but spawned in and possibly below the Clackamas River. A small number of silver salmon still enter the Clackamas, Molalla, and Tualatin Rivers. A good run of spring chinook salmon, comprising a significant part of the badly depleted spring run of the Columbia, enters the Willamette from March to early June. These fish enter nearly all of the streams arising on the Cascade Mountain slopes and remain in large, deep resting pools until the time of spawning, which usually begins with the first fall rains. No chum or blueback salmon are found in the Willamette River system. A fair run of spring steelhead trout still ascends some of the tributaries.

Of all the adverse factors contributing to the depletion of the former great runs of anadromous fish in the Willamette River, pollution is the most important. The raw domestic and industrial wastes discharged into the river from one end of the Willamette Valley to the other have, in addition to their inherent toxic affects, such a biochemical oxygen demand that except during flood or freshet stages the lower reaches of the river are virtually devoid of oxygen. The lack of oxygen acts as a barrier to the passage of both upstream and downstream migrating fish, and is responsible for the disappearance of the fall runs of salmon in this system.

The pollution load carried by the Willamette River is better comprehended when it is considered in terms of population and numbers of contributing industries. According to the 1940 census the population of the Willamette Valley was 686,011. This population has greatly increased in recent years, especially in the Portland area. The Oregon State Planning Board found in 1937 that of the 1,637 industrial establishments in the State, 853 were located in the Willamette Valley. These included 7 pulp and paper mills, 47 canneries of all kinds, 270 sawmills, 4 flaxretting plants, 64 laundries, 3 gas works, 20 mines, 9 woolen mills, and 66 others. Gleeson and Merryfield (1936) estimated that the waste products from just the four pulp mills located at Oregon City had an oxygen demand equal to "a population of 489,000 persons". The greater part of the waste products of the human population and the industries is carried by the Willamette River.

Figure 4.-- Area two - Sub-Area Willamette

The pollution problem is a major factor in the plan for the rehabilitation of the runs of migratory fish in the Willamette River system. It is a problem of such magnitude and complexity that no effort is made to present it completely in this report.

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The Survey

25. Willamette River.--(June 6-9, 1938; Hanavan, Parkhurst Morton, Langton, and Wilding.) Enters the Columbia River 101 miles above the mouth, and extends for approximately 189 miles to the confluence of the Coast and Middle Forks. Throughout most of its course the river is sluggish and the stream bed is composed of mud and silt. The detailed survey was started at the first good riffle, located about 7 miles below the mouth of the McKenzie River, and covered the upper 18 miles of the main stream.

The average flow at Harrisburg, 11 miles below the mouth of the McKenzie River was 9,477 c.f.s., the maximum 82,600 c.f.s., on February 14, and the minimum 1,990 c.f.s., on October 30, according to U.S.G.S. records for the water year 1944-45. Floods of much greater volume than the above maximum occur in some years.

There are no total barriers to fish on the main Willamette River. Willamette Falls at Oregon City, about 23 miles above the mouth, has interfered with the passage of migratory fish. The fishway over the falls has been improved recently by the Oregon Fish Commission, and is the subject of further study.

* Streams that were too small or too steep to warrant survey.

A power dam 8 feet in height located just above the city of Eugene is provided with a fishway and is not a barrier to fish.

The main Willamette River is of value to fish chiefly as a passageway to the principal tributaries where the best spawning grounds are located. A few spring chinook salmon may spawn in the main river near the mouth of the McKenzie and in the 10 mile section above.

25A. Johnson Creek.—(February 2, 1935; Brown and Christy.) Enters the Willamette at Milwaukie, Oregon, 17 miles above the mouth. It is 22 miles long, the lower 20 miles having been surveyed. The stream was discharging 75 c.f.s. It is scarcely more than a badly polluted slough, with large areas of the bottom covered with mud, silt, and debris. Four low dams and several log and brush jams make the creek impassable at low water stages. The stream is practically useless in its present state, although a few spring chinook and steelhead have been reported to enter at high water stages.

25B. Clackamas River.—(June 26-29, 1938; Hanavan, Wilding, and Morton, August 23, 1940; Parkhurst and Bryant.) Enters the Willamette River about 21 miles above the mouth. The stream is about 80 miles long, of which the lower 27 miles up to Cazadero Dam were surveyed. The extreme discharges of record at Cazadero Dam ranged from a minimum of 410 c.f.s., on October 20, 1925, to a maximum of 60,800 c.f.s., on March 31, 1931, and the average discharge was 2,544 c.f.s. The flow during the fall spawning period ranges from 600 to 1,000 c.f.s.

River Mill Dam, constructed in 1911, is located 23 miles above the mouth. It is 80 feet high and has partially blocked runs of migratory fish ever since its construction, as the fish ladder never has been satisfactory. A few fish manage to pass over the ladder, but many are unable to ascend.

Cazadero Dam, built in 1904, is located 27 miles above the mouth, and is 60 feet high. A fish ladder was provided in 1939, but only an occasional salmon has been observed to pass over the dam. A few steelhead trout are reported to ascend the ladders at both dams.

A small remnant of the former run of spring chinook salmon persists in the Clackamas River, there being approximately 500-2,000 fish in the run in recent years. In August 1940, 300 spawners were observed just below Cazadero Dam, and more than 500 below River Mill Dam. Neither group of fish was able to ascend farther.

25B-(1). Rock Creek.—

25B-(2). Clear Creek.—

25B-(3). Deep Creek.—These small streams were not surveyed.

25B-(4). Eagle Creek.—(June 25, 1938; Hanavan, Wilding, and Morton.)

Enters the Clackamas River approximately 17 miles above the mouth. The stream is about 22 miles long, of which the lower 9 miles were surveyed up to Eagle Creek Falls. The stream width ranged from 30 to 90 feet, and the water temperature was 60-65° F.

A small falls below Eagle Fern Park in the lower section of the stream was provided with a fishway about the year 1940, but might be improved. Eagle Creek Falls, 18 feet high, recently has been greatly improved for fish passage by the construction of a new ladder by the Oregon Fish and Game Commission.

There is good spawning area up to Eagle Creek Falls sufficient to accommodate at least 3,000 fish. The remainder of the stream should be surveyed.

A fair run of spring chinook and a few silver salmon enter the stream. It was reported in September and October 1941 that there were 500 - 700 spring chinooks spawning in Eagle Creek, and others at the confluence with the Clackamas. There is also a fair spring run of steelhead trout.

25B-(4)a. North Fork of Eagle Creek.--(June 26, 1938; Morton.) Enters Eagle Creek 5 miles above the mouth. The stream is 10 miles long, of which the lower 4 miles were surveyed. The stream had an average width of 12 feet, and was discharging 20 c.f.s.

The lower 2 miles of the watershed had been recently stripped by a logging operation, and the stream was jammed with logging debris.

There is spawning area available for several hundred salmon. The stream is evidently a good producer for its size, many chinook and silver salmon fingerlings having been observed.

25B-(4)b. Delph Creek.--(June 26, 1938; Wilding.) Enters Eagle Creek 8 miles above the mouth. The stream is about 9 miles long, of which the lower 3 miles were surveyed up to the 4 foot high U. S. Fish Hatchery dam. The stream was discharging 7-8 c.f.s. The gradient is steep, and there are numerous small falls, cascades, and debris jams. There is little spawning area in the stream.

A small run of steelhead trout are able to pass the hatchery dam at high water, but during low water periods the entire flow is diverted for hatchery use.

25C. Abernethey Creek.--This small stream entering the Willamette 1/2 mile above the Clackamas River is of no value to salmon.

25D. Tualatin River.--(September 14-15, 1940; Frey and Zimmer. September 11-12, 1945; Hanavan and Parkhurst.) Enters the Willamette

River 24½ miles above the mouth. The stream is about 70 miles long. The lower 5 miles and the upper 15 miles have a moderate gradient and contain some spawning area. The middle 50 miles of this stream meanders through a flat, fertile, cultivated valley, and contains little suitable spawning area. Starting at Cherry Grove, approximately 60 miles above the mouth, the stream was surveyed for a distance of 5 miles. The discharge from July through October usually ranges from 10 to 100 c.f.s.

The Oswego diversion dam, located 4½ miles above the mouth, is about 5 feet high and is equipped with a fishway. The Oswego diversion canal, located 6 miles above the mouth, diverts an average of 69 c.f.s., to Oswego Lake and powerhouse below. The return is discharged directly into the Willamette. The diversion take-off is not screened.

Lee Falls, located 3 miles above Cherry Grove is 12 feet high and is a total barrier to fish. There is little suitable spawning area above the falls.

A few spring chinook and silver salmon and steelhead trout enter the stream, but the Tualatin has never been an important salmon producer. Numerous small tributaries are of no value to migratory fish because of their lack of spawning area.

25D-(1). Dawson Creek.--(September 22, 1940; Frey and Zimmer.) Enters the Tualatin River approximately 36 miles above the mouth. The stream is about 5 miles long, and was discharging about 4 c.f.s. The stream bed is composed almost entirely of mud and silt, with little or no suitable spawning area. Dawson Creek was considered to be of no value for the production of salmon.

25D-(2). Dairy Creek.--(September 22, 1940; Frey and Zimmer.) Enters the Tualatin River approximately 41 miles above the mouth. The stream is about 25 miles long, and the discharge was 8 c.f.s. At the town of Manning, about 15 miles above the mouth, there is a 5 foot high dam for a log pond. This dam is provided with a fishway. The stream contains little suitable spawning area, and was considered to be of no value to migratory fish.

25D-(3). Gales Creek.--(September 16-21, 1940; Frey and Zimmer. September 12, 1945; Parkhurst, Brewington, and Davis.) Enters the Tualatin River approximately 50 miles above the mouth. The stream is about 30 miles long, of which 15 miles were surveyed, starting 2 miles above the mouth. Gales Creek has had winter floods as high as 3,500 c.f.s., and discharges during the summer low water period as low as 6 c.f.s. The mean flow for the water-year 1944-45 was 162 c.f.s. in the lower section near the town of Forest Grove (U.S.G.S. records). The great fluctuation in volume has been due largely to major forest fires in the upper watershed. The gradient is slight to moderate and the water temperature ranged from 53 to 69° F.

There was a gravel pit and washer with a drag line taking gravel from the stream bed at a point 2½ miles above the mouth. Log jams, impassable at low water, were found 11½ miles upstream, 15½ miles upstream, and 17 miles upstream. Slightly over 13 miles upstream there was a water wheel, impassable at low water, operating a small irrigation pump. Finally, 17½ miles upstream or just below the mouth of the South Fork there is a 12 foot high lumber mill dam. This dam is provided with an efficient fishway, and salmon have been observed going through it. There are several other small log jams and old low dams, none of which are barriers to fish. There are also a number of small irrigation diversions, most of them supplied by screened pumps.

A small run of spring chinook salmon is able to pass most of the stream obstructions at spring high water, and several of them were observed spawning in the middle section of the stream. Although not observed, a few silver salmon and steelhead trout also have been reported. There is suitable spawning area for at least 4,000 salmon in the lower 11 miles, below the first bad log jam, and spawning area for at least 1,500-2,000 additional fish above. The best spawning areas occur in the middle section of the stream. This stream can support a much larger salmon population, particularly with needed stream improvements and restocking. Resident trout were observed in the upper section.

Clear Creek, Iler Creek, Glenwood Creek, and the South Fork.--- All had flows of 2-4 c.f.s., and may have some value to fish.

25D-(12). Scoggins Creek.---(September 17, 1940; Frey and Zimmer. September 11-12, 1945; Hanavan, Rucker, and Silliman.) Enters the Tualatin River approximately 53 miles above the mouth. The stream is about 18 miles long, of which 4½ miles were surveyed. The recorded flow near the mouth ranges from slightly more than 1 c.f.s., to more than 1,600 c.f.s., with the mean flow for the water year 1944-45 being 102 c.f.s.,(U.S.G.S. records). This great fluctuation decreases any possible value the stream might have for fish production.

A dam 4 feet high located about 5½ miles above the mouth is a barrier to fish at low water. Another dam 5 feet high located about 7 miles above the mouth is also a barrier at low water. Three log jams in the upper section should be removed.

There was sufficient spawning area below the lower dam at the time of the 1945 survey to accommodate at least 600 salmon, and sufficient spawning area above this obstruction to accommodate a somewhat greater number. However, at times of low flow conditions a large part of this spawning area is exposed.

It was reported by several local residents that a few chinook and silver salmon enter the stream during the late fall rains. A small number of steelhead trout also were reported, and some salmon fingerlings were observed. The stream is regarded as being of only slight value as salmon producer.

25E. Beaver Creek.--This small stream enters the Willamette River about 27½ miles above the mouth, is about 8 miles long, and has not been surveyed. It and its tributary, Parrot Creek, are believed to be of little if any value to salmon.

25F. Molalla River.--(September 5-11, 1940; Frey and Zimmer. September 17-25, 1941; Frey and Bryant.) Enters the Willamette River about 31½ miles above the mouth. The stream is approximately 50 miles long, of which the lower 38 miles were surveyed. The maximum discharge was 22,300 c.f.s., on March 31, 1931, and the minimum 25 c.f.s., on September 14, 1938. The lowest flows occur from August through October when the flow is usually under 100 c.f.s. This is the period of salmon spawning in the stream. In the section surveyed the stream was 40-100 feet wide. The gradient is slight in the lower 25 miles, becoming moderate above.

About 9 miles above the mouth there is a low gravel pit dam that should be provided with a channel for fish at low water stages. About 10½ miles upstream there is an 11 foot high dam on a side channel that forces migratory fish to drop downstream and ascend the other channel. There is a 2-foot high stone dam 11 miles above the mouth diverting water to a swimming pool. This dam should be provided with a passageway for fish at low water stages. There is a 5-foot high rock dam located 13½ miles upstream that has a break at one end and making it passable to fish. There was a low temporary dam 18 miles above the mouth diverting one-fifth of the stream flow to a rock crusher. Fish can pass the gravel bars at this point if a definite channel is maintained for them. There is a wooden irrigation diversion dam 18½ miles upstream that is 2 feet high, diverts 17½ c.f.s., and is impassable at low water. There is a low stone dam 19 miles upstream that is impassable at low water. There is a series of five low dams immediately upstream that should be notched for the passage of fish at low water. There is a low dam for a swimming pool 19½ miles upstream that should be provided with a channel for fish at low water. A 2-foot high irrigation diversion dam 19.8 miles upstream is a barrier at low water. It diverts water into a side channel and thence into an irrigation ditch. There is a wooden diversion dam 2 feet high located 23.2 miles upstream that is a barrier at low water. The dam diverts into a side channel from which an irrigation flume withdraws more than 2 c.f.s.

Just below the confluence of the North Fork, or 24.8 miles above the mouth, there is a fast rapids with the stream dropping 10 feet in a distance of 50 feet that could be improved for fish passage. A 6-foot cascade located 26.2 miles upstream could also be improved for passage of fish at low water.

All of the diversions on the stream should be screened.

The lower 20 miles of the stream extend through a wide valley bottom, and this section is little used by spawning salmon. The water temperature in this lower section ranged from 60-72° F., and the spring

chinook pass to the large deep, and cooler resting pools in the middle section. The spring chinooks remain in these resting pools from July through early September, and then move on to the spawning riffles in the middle and upper sections of the stream. This movement usually occurs after the first fall rains, and it is important that the numerous low water barriers be improved to facilitate fish passage at this season. There are extensive spawning areas in the preferred middle and upper sections of the river sufficient to accommodate at least 5,000 salmon. In the year 1940 a total of 882 spring chinook spawners was counted, and more were present. In the year 1941 a total of 993 was counted, and in addition an unknown number entered the South Fork. Details of the spawning area utilization are given by Rich (1948) in the introduction to this report series. A few silver salmon and a good run of steelhead trout also enter the river.

The Molalla has proved value for salmon, and aided by stream improvements and protection it should become even more important from this standpoint. The remainder of the stream and the unsurveyed portion should be examined in detail at spawning time.

25F-(1). Pudding River.--(September 6, 1940; Parkhurst and Bryant.) Enters the Molalla 1 mile above the mouth. The stream is about 55 miles long. The stream course meanders entirely on the Willamette Valley floor, and at no place does the gradient exceed 5 feet per mile. This sluggish mud bottom stream is of value to salmon and trout mainly as a passageway to several of its tributaries. The discharge over a 17 year period ranged from 37 to 13,800 c.f.s., but during the summer the flow is generally 50-75 c.f.s.

A mill dam 4 feet high near the village of Pratum in the extreme upper section of the stream is a barrier at low water.

The Pudding River is one of the most badly polluted streams ever observed by the survey party. Garbage and fruit cannery wastes in the vicinity of Woodburn and Hubbard, Oregon had so badly contaminated the water with an oily emulsion that large numbers of suckers, chubs, lampreys, catfish and even crayfish were found dead. It is believed that only spring run fish that ascend to the tributaries during spring high water stages can exist in this stream system until the pollution has been eliminated.

25F-(1)a. Mill Creek.--

25F-(1)b. Rock Creek.--These are small streams of no possible value to salmon.

25F-(1)c. Butte Creek.--(Inspected September 20, 1940; Parkhurst and Bryant.) Enters Pudding River about 15 miles above the mouth, and is 32 miles long. The recorded discharge ranges from 5 to 4,410 c.f.s., but the average flow from July through October generally averages less than 20 c.f.s.

The lower 9 miles are in the gently rolling Willamette Valley where the stream bed is composed largely of mud and silt. Above this point the gradient gradually increases and the stream bed is composed largely of bedrock and boulders.

The 8 foot high Lima Dam, located 9¼ miles upstream is a barrier to migratory fish, as is also the similar Hartman Dam located 10¼ miles upstream.

The Scotts Mills power dam, located 11 miles upstream is 4 feet high, but is built on the crest of a 14 foot natural falls, and is impassable to fish.

There is a 20-foot impassable falls 300 yards above the Scotts Mills Dam.

There is practically no available spawning area in this stream, and no runs of salmon have been reported.

25F-(1)d. Zollner Creek.--Small sluggish streams of no possible

25F-(1)e. Little Pudding River.--value to salmon.

25F-(1)f. Abiqua Creek.--(September 8-15, 1940; Parkhurst and Bryant.) Enters Pudding River about 35 miles above the mouth. The stream is approximately 32 miles long of which the lower 20 miles were surveyed up to impassable 100-foot high Abiqua Falls. The flow at a point 6 miles above the mouth was 19 c.f.s.

The Abiqua Dam, located 10 miles upstream, is 16 feet high and supplies water to the town of Silverton through a screened diversion. A poor fish ladder is present.

There is spawning area available for at least 6,000 salmon in the section surveyed.

Approximately 50 spring chinooks were held up at the dam until the survey crew removed debris from the fish ladder. Approximately 200 chinook spawners were observed in the next 6 miles above the dam.

Logging operations being carried on along the stream in the next 3 miles were found to be obstructing the stream in several places.

25F-(1)g. Silver Creek.--(September 28-29, 1940; Parkhurst and Bryant.) Enters Pudding River about 38 miles above the mouth. The stream is approximately 14 miles long to the confluence of the north and south forks. The lower 5½ miles were surveyed in detail, and the upper section was inspected. The discharge was 42 c.f.s., and the water temperature was 53-55° F.

The first major obstruction is a planer mill dam in the town of Silverton, approximately 3½ miles upstream. This dam is 12 feet high, and during the summer diverts the major part of the stream flow. It is equipped with an inadequate fish ladder, which was dry and debris plugged at the time of observation.

A concrete dam 5 feet high is located 1/4 mile farther upstream. This dam is provided with two fish ladders.

A low log dam 100 yards farther upstream is used to provide a swimming pool, and is a barrier at low water.

The remains of an old wooden dam 125 yards farther upstream were a barrier at low water.

An unused dam and fish ladder 200 yards farther upstream is passable to fish.

In the next two miles there are two low falls, one of which is 6 feet high and impassable at low water.

There are high falls on both forks of the stream, the one on the South Fork being 146 feet high and that on the North Fork 184 feet high.

There is sufficient area available up to the Silverton Dam for about 500 salmon. In the next two miles up to Izaak Walton Park there is spawning area available only at high water for about 600 salmon. There is little suitable spawning area above this point.

There were no reports of salmon in Silver Creek, and the stream is of little possible value to migratory fish.

25F-(1)h. Drift Creek.—(September 30, 1940; Parkhurst and Bryant.) Enters Pudding River about 40 miles above the mouth. The stream is about 15 miles long, of which only the lower mile contains sufficient spawning area to warrant a detailed survey. It was 15-30 feet wide and discharging 5½ c.f.s.

About 1 mile above the mouth there is a 2-foot high diversion dam which diverts most of the flow during low water stages.

There is sufficient spawning area in the lower mile below the diversion dam for about 300 salmon. Above this point there is little suitable spawning area.

The North Fork enters about 8 miles above the mouth, and is blocked to migratory fish by a 35-foot high falls about 1½ miles above the confluence with Drift Creek.

According to local reports, no salmon have been seen in Drift Creek for many years, and it was considered of little possible value to migratory fish.

25F-(1)i. Beaver Creek.—

25F-(1)j. North Fork, Pudding River.—

25F-(1)k. South Fork, Pudding River.—These small, sluggish tributaries to the Pudding River were inspected and found to be of no present or potential value to salmon.

25F-(2). Gribble Creek.—Enters the Molalla River 4 miles above the mouth. It is a small, sluggish stream about 6 miles long, discharging less than 1 c.f.s., and is of no value to salmon.

25F-(3). Milk Creek.—(Inspected September 6, 1940; Frey and Zimmer.) Enters the Molalla River about 6 miles above the mouth, and extends for about 25 miles. The discharge was 7-10 c.f.s. at a low water stage. It is a sluggish stream with a heavily silted stream bed throughout most of the course, and there is little suitable spawning area.

The Mulino irrigation diversion dam, located about 5 miles above the mouth, is 10 feet high and is impassable to fish.

The Union Mills feed mill dam, located about 8 miles above the mouth, is 13 feet high and is impassable to fish.

The stream is of no present value to salmon and it is probable that stream improvements for fish would not be warranted.

25F-(4). North Fork, Molalla River.—(September 11, 1940; Frey.) Enters the Molalla River about 25 miles above the mouth. The stream is approximately 25 miles long, of which only the lower 1½ miles were surveyed. The stream was 33 feet wide in the lower section, with a moderate gradient. There are few good spawning riffles in the lower section. However, spring chinook salmon are known to congregate in a long, deep pool formed by a narrow rock gorge approximately 3½ miles above the mouth. These fish move farther upstream to spawn. There is known to be a fairly good run of spring chinook salmon into the North Fork, although no actual count was attempted. There is also a good run of steelhead trout and a large number of small resident trout. Several unsurveyed tributaries are known to be of some value as spawning and rearing areas for both salmon and trout.

25F-(5). Trout Creek.—(Inspected September 8, 1940; Zimmer.) Enters the Molalla River approximately 25½ miles above the mouth. The stream is about 6 miles long, 6 feet wide, 1-2 feet deep, and discharging approximately 6 c.f.s. The gradient is steep, the stream

cascading down a bedrock channel. Trout Creek was considered of little possible value to salmon, although it may be of some value to steelhead and resident trout.

25F-(6). Pine Creek.--(Inspected September 11, 1940; Zimmer.) Enters the Molalla River about 30 miles above the mouth. The stream is approximately 7 miles long and was discharging about 10 c.f.s. The gradient is steep, and the stream bed is mainly bedrock and boulders. There were several reports of salmon in Pine Creek. However, it is considered of little value to salmon, although of some possible value to steelhead and resident trout.

The two principal tributaries to the upper Molalla River, forming the main stream at their confluence, are Table Rock (or Middle Fork) and the South Fork. Neither of these was surveyed.

25G-M. Several small tributaries to the main Willamette were considered as of little or no value to salmon and were merely inspected. Among these were Newland Creek, entering 32 miles above the mouth, Boeckman Creek, entering about 34 miles upstream, Corral Creek, entering 36 miles upstream, Champoeg Creek, entering 40 miles upstream, Mission Creek, entering about 41 miles upstream, Hess Creek, 43 miles upstream, and Chehalem Creek, 46 miles upstream. All of these streams on the Willamette Valley floor have very slight gradients, stream beds composed mainly of mud, and very small flows in the summer and early fall months.

25N. Yamhill River.--(Inspected September 26, 1940. Frey and Zimmer.) Enters the Willamette River about 50½ miles above the mouth. The main Yamhill extends for 10½ miles to the confluence of the North and South Forks. The discharge ranges from a minimum of 35 c.f.s., in September to a maximum of 27,000 c.f.s., in April.

The U. S. Government Locks are located near the town of Lafayette, 7 miles above the mouth. A fish ladder is provided, and is passable when kept free of debris.

The river is sluggish, usually turbid, and lacks suitable salmon spawning area.

25N-(1). Palmer (or Mill) Creek.--(Inspected September 26, 1940; Frey and Zimmer.) Enters the Yamhill River 5 miles above the mouth, and is approximately 9 miles long. The discharge was 4-5 c.f.s., and the gradient is slight. The stream is sluggish, turbid, and lacking in spawning area. It is of little or no possible value to salmon.

25N-(2). North Yamhill River.--(Lower 13 miles inspected September 13-14, 1945; Parkhurst, Rucker, and Brewington. Next 10½ miles surveyed October 1, 1945; Brewington, Davis, and Johanson.) Joins the

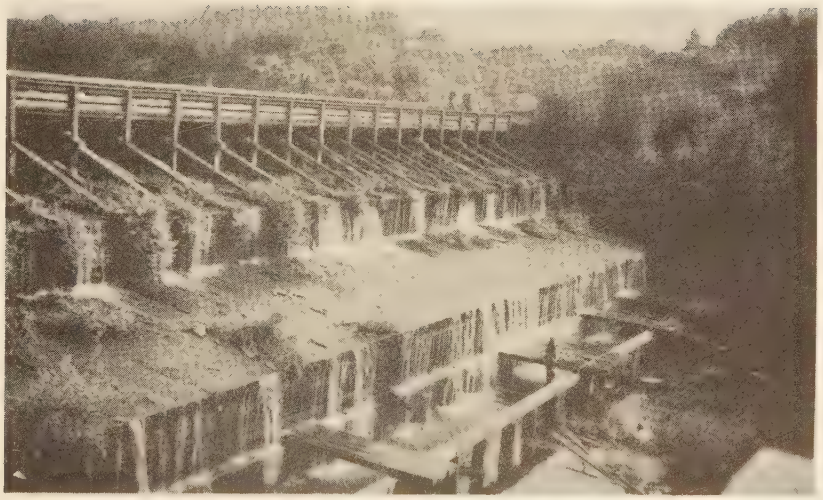

Figure 5.-- Lumber mill dam at Carlton, Oregon, on North Fork, Yamhill River; an obstruction to migratory fish.

South Fork to form the main Yamhill River 10½ miles above the mouth of the latter. The stream is 26 miles long. The discharge was approximately 12 c.f.s. Floods of over 4,000 c.f.s., have been recorded. The water temperature ranged from 50° to 61° F.

The lower 13 miles is all slough area, with the stream bed covered with mud and silt at all points inspected. A gravel crusher at this point washes silt into the stream.

The Carlton lumber mill dam, located 7 miles above the mouth, is 30 feet high and is a total barrier to fish. A former fishway has been abandoned and is beyond repair. Except for considerable leakage through the dam, the entire flow is diverted during low water periods.

An old abandoned lumber dam located about 21½ miles above the mouth is at least a partial barrier to fish.

There are two log jams 22-23 miles upstream, the upper one being impassable to fish.

There is very little spawning area in the lower 15 miles. There is spawning area for more than 3,000 salmon in the next 9 miles, all of which is unavailable because of the Carlton Dam.

With stream improvements and stocking the stream should be able to support runs of chinook and silver salmon and steelhead.

25N-(2)a. Panther Creek.--(Inspected September 28, 1940; Frey and Zimmer.) Enters the North Yamhill 3 miles above the mouth. The stream is about 11 miles long. The discharge was 15 c.f.s., and the water temperature was 56° - 66° F.

A sawmill diversion dam and waterwheel located about 3 miles upstream is a barrier to fish at low water.

The lower 5 miles of the stream contains a large amount of mud and silt. The upper section contains some good spawning areas.

There were no reports of salmon in the stream.

25N-(2)a-i. Baker Creek.--(Inspected September 28, 1940; Frey and Zimmer.) Enters Panther Creek 1/2 mile above the mouth. The stream is about 18 miles long. It was 15 feet wide near the mouth, and the water temperature was 56° F. This stream is similar to Panther Creek, except that it is smaller and has less spawning area.

25N-(3). South Yamhill River.--(Inspected September 28-30, 1940; Frey and Zimmer.) Joins the North Fork to form the main Yamhill River 10½ miles above the mouth of the latter.

The stream originates in the Coast Range, and is 52 miles long. The discharge in the year 1938 was a minimum of 3 c.f.s., on August 22, and 14,000 c.f.s., on December 27. The water temperature was 59°-61° F.

The lower section of the stream is sluggish and heavily silted. There is considerable spawning area in the middle and upper sections.

The South Yamhill is of little present value to salmon.

25N-(3)a. Salt Creek.--(Inspected September 28, 1940; Frey and Zimmer.) Enters the South Yamhill about 17 miles above the mouth. The stream course is about 30 miles long. Since it was dry at a point about 10 miles above the mouth it is believed to be of little possible value to salmon.

25N-(3)b. Deer Creek.--(Inspected September 28, 1940; Frey and Zimmer.) Enters the South Yamhill about 20 miles above the mouth. The stream is about 18 miles long. The lower 10 miles of the course is in a cultivated valley where the stream bed consists mainly of mud and silt. At a point 10 miles above the mouth the stream was 20 feet wide, flowing 6-8 c.f.s., and the water temperature was 56° F. Above this point the stream contains a large amount of bedrock and some spawning rubble. The stream is of slight possible value to salmon.

25N-(3)c. Mill Creek.--(Inspected September 30, 1940; Frey and Zimmer.) Enters the South Yamhill about 33 miles above the mouth. The stream is about 25 miles long, and was flowing 25 c.f.s., at a point 6 miles above the mouth. The water temperature was 56° - 64° F. The greater part of the stream course extends through a heavily wooded, hilly section, although logging operations were being carried on in the headwaters. The stream bed contains a large amount of bedrock, but also contains some good spawning area. The stream appears to have possibilities for the production of salmon and trout.

A tributary, Gooseneck Creek entering 3 miles upstream, is about 7 miles long and has some additional spawning area.

25N-(3)d. Willamina Creek.--(October 2-4, 1945; Brewington, Davis, and Johanson.) Enters the South Yamhill about 35 miles above the mouth. The stream is about 20 miles long, of which the lower 10 miles were surveyed up to an impassable falls 10 feet high. The discharge was 15 c.f.s., at the time of survey. The maximum discharge of record was 5,720 c.f.s., on December 27, 1937, and the minimum has been 9 c.f.s., on several occasions in August and September. The water temperature was 48° - 54° F.

There is a 16-foot high power dam of the Portland General Electric Company located 1½ miles above the mouth. The fishway at the dam was badly in need of repairs and maintenance.

A second waterfall 18 feet high was reported a short distance above the upper terminus of the survey.

There are a number of electric pumps diverting water from the lower section of the river.

The lower 1½ miles of the stream is badly polluted by sewage and sawmill waste from the town of Willamina.

The lower 2 miles is sluggish, with no salmon spawning area. The next 8 miles up to the falls contains sufficient spawning area for at least 1,500 salmon. Above the falls the stream contains a large amount of bedrock and little spawning area. No migratory fish were seen or reported in Willamina Creek.

Coast Creek, entering 3½ miles upstream, had a flow of 3 c.f.s., and a small additional amount of spawning area.

The East Fork, entering 7 miles upstream, had a flow of 4 c.f.s., and was believed to be of little possible value to migratory fish.

25N-(3)e. Rock Creek.--(October 4, 1945; Brewington and Johanson.) Enters the South Yamhill about 44 miles above the mouth. The stream is about 9 miles long, of which the lower 5 miles were surveyed. It was discharging 20 c.f.s., but during the summer the discharge becomes as low as 2 c.f.s.

Three log jams, two of which were impassable, were located between 2 and 4 miles above the mouth. Three falls, 6, 6, and 9 feet high, were located between 4 and 5 miles upstream, and all were at least barriers at low water.

There was spawning area for 1,000 salmon below the first impassable log jam, and spawning area for a few hundred more fish could be made available up to the falls. The stream area above the falls does not warrant construction of fishways. No migratory fish were seen or reported.

25N-(3)f. Agency Creek.--(September 14, 1945; Hanavan, Silliman, and Davis.) Enters the South Yamhill about 45 miles above the mouth. The stream is 14 miles long, of which the lower 4½ miles were surveyed. The discharge was 7 c.f.s., and the water temperature was 62°- 63° F. Two beaver dams and a log jam near the upper terminus of the survey were barriers to fish at low water. A series of 3 falls, each 3-4 feet high, and with a log jam above them, located at the upper end of the survey were at least barriers to fish at low water.

There was spawning area available for at least several hundred salmon in the section surveyed. No migratory fish were seen or reported.

25-O. Spring Valley Creek.—Enters the Willamette River approximately 70 miles above the mouth. This small stream meanders in the Willamette Valley floor for a distance of about 6 miles. It is of no value to migratory fish, and was not surveyed.

25P. Mill Creek.—Enters the Willamette River at Salem, Oregon, approximately 80 miles above the mouth, and is 25 miles long. The discharge of record ranges from no flow to 1,110 c.f.s., with mean flows of 135-250 c.f.s.

This stream has a large power diversion just above the mouth and many unscreened irrigation diversions. The stream in itself would be unimportant to salmon, but the fact that the unscreened Salem Ditch, entering 18 miles above the mouth, diverts the major portion of the North Santiam River during part of the year into Mill Creek makes the latter of great importance to salmon and steelhead. Nearly the entire salmon and steelhead production of the North Santiam River occurs above the Salem Canal, and a large number of downstream salmon and steelhead migrants, both natural and hatchery produced, are thus subjected to undue hazards.

25Q. Rickreall Creek.—(Not surveyed) Enters the Willamette River approximately 85 miles above the mouth. The stream is about 25 miles long. Although it is generally a fair sized stream, 15-25 feet wide, and contains some spawning area, it is of no importance to salmon.

25R. Luckiamute River.—(Not surveyed) Enters the Willamette River approximately 103 miles above the mouth. The main stream is about 50 miles long. The discharge of record ranges from 25 c.f.s., to more than 14,000 c.f.s., with a mean annual discharge of 848 c.f.s. In the lower part of its course on the Willamette Valley floor the stream is sluggish and the bottom is mud covered, with no suitable salmon spawning area. The stream was considered of little possible value to salmon. The Little Luckiamute River, entering 14 miles above the mouth and extending 21 miles, is the principal tributary.

25S. Santiam River.—(August 2-3, 1940; Parkhurst, Bryant, Frey, and Zimmer.) Enters the Willamette River approximately 104 miles above the mouth. The river enters the Willamette through two channels one mile apart, the upper or south channel being the larger. The north channel is sometimes designated as the Little Santiam River. These channels converge less than 3 miles above the mouth. The main stream is 11 miles long, and was completely surveyed. The discharge ranges from a minimum of 260 c.f.s., in late August, 1940, to a maximum of 176,000 c.f.s., on November 21, 1921. The discharge at the time of survey was 418 c.f.s. The maximum run-off, always high in spring due to heavy mountain snow melt, has been increased in recent years by extensive timber cutting on the upper watershed. The low flow in late summer is caused by the withdrawal of large volumes of water from tributaries for

irrigation, industrial, and domestic uses. The stream course is entirely on the flat Willamette Valley floor, which is farmed extensively, and has an average gradient of only 5.4 feet per mile. As the stream meanders through the flat plain it has cut a very wide flood channel; during low water periods the stream occupies less than one-third of this channel. Cut-banks occur frequently at the bends of the stream, and since the banks are composed mainly of earth, sand, and gravel, erosion at these points has been severe.

The low summer flows over a wide, shallow stream bed apparently have increased water temperatures from June through September to a point where they are unfavorable for migratory fish. The survey party found water temperatures ranging from 68 - 76° F., and on September 16 the water temperature was 70.5° F., near the mouth, and 70° F., at Jefferson, 9 miles above the mouth. Consequently, the resident fish population of the main Santiam consists mainly of rough fish such as chubs, squawfish, and suckers. Runs of spring chinook salmon and steelhead pass through the warm waters of the main Santiam to the cooler waters of the principal tributaries, but the main stream presents definite hazards to the passage of downstream migrants.

Pollution, silting, and water discoloration occurs generally throughout the section from the mouth to the confluence of the South Santiam. The pollution condition has forced the town of Jefferson to discontinue use of the Santiam for its domestic water supply.

There are many deep resting pools and good riffles with spawning area available for several thousand salmon in the main Santiam. However, under present conditions this area is not suitable for utilization by salmon and trout.

25S-(2). North Santiam.—(August 5-12, 1940; Parkhurst, Bryant, Frey, and Zimmer, mouth to Detroit dam site. September 24-26, 1937; Hanavan, Lobell, Baltzo, and Kolloen, remainder of stream.) Joins the South Fork to form the main Santiam 11 miles above the confluence with the Willamette River. The stream is 92 miles long, of which 87 miles were surveyed. It originates near the summit of the Cascade slope between Mount Three Fingered Jack and Mount Jefferson.

The maximum discharge recorded at Mehama, 28 miles above the mouth and upstream from the principal diversions, was 62,900 c.f.s., on November 20, 1921, and the minimum was 400 c.f.s., September 29 and October 13, 1934. The survey party measured a flow of 209 c.f.s., at the mouth, less than 25 c.f.s., at the Stayton-Kingston bridge, between the diversions at Stayton and their return, and 480 c.f.s., at the Mehama highway bridge. The water temperature ranged from 54 - 61° F. On September 16 water temperatures were taken at a series of 10 stations from the mouth to a point 68 miles upstream and ranged from 52° - 69° F. The gradient in the lower 28 miles is slight (12.4-17.5 feet per mile), the stream is

quite open and, like the main Santiam, is subject to high temperatures in the summer and fall months. However, the water temperatures are not as critical as in the main Santiam, and the spawning areas are utilized to some extent, particularly in the upper 10 miles of this section.

In the next 31 miles to the confluence of the Breitenbush River the gradient is moderate (17.5-31.3 feet per mile). In this section the stream is much narrower as it passes through the confines of a deep, rocky gorge.

The remainder of the stream has a much steeper gradient (59-62 feet per mile).

The Jefferson Ditch is located just above Green's bridge, 3 miles above the mouth. The Sidney Ditch is located about 9 miles above the mouth, and carries 8 c.f.s., for irrigation purposes. Neither of these diversions, taking off from side channels, have dams that would obstruct fish, but neither of them are screened to prevent the loss of fingerlings.

The first obstacles to the upstream migration of fish are in the vicinity of Stayton, where the river is divided into a maze of channels.

During low water periods the upper Gardiner Dam on the south channel diverts practically the entire flow down the North Channel. This dam, formerly impassable to fish, was provided with a fishway in 1947. In the North Channel, about 1½ miles below the upper Gardiner Dam, a wing dam extending nearly two-thirds of the distance across the channel diverts most of the flow into the unscreened Salem Ditch, which empties into Mill Creek (see latter, 25 N.) The remainder of the flow in the North Channel is diverted a short distance below by the lower Gardiner Dam into the Gardiner Ditch leading to the Stayton power canal. Water is taken from the latter canal in the town of Stayton for the Paris Woolen Mill powerhouse, the Gardner Feed Mill, the Stayton Water Company Pumping Plant, the Mountain States Power Company powerhouse, and a wool batt factory. Water is collected below these diversions by the Stayton Wasteway, from which the West Stayton Ditch diverts up to 80 c.f.s., for irrigation. The latter ditch was provided with a broken-down fish screen. The remaining flow in the Stayton Wasteway empties into the North Santiam nearly 1 mile below Stayton. As during low water periods the flow in the Stayton Wasteway return is greater than that in the main river the majority of migrating adult salmon are attracted into the wasteway. A fish ladder at the Mountain States Power Plant is the only way by which these fish can pass from the wasteway into the power canal and thus to the upper river. On several inspection trips this ladder was found to be dry and obstructing the passage of spring chinook salmon congregated below. Most of the diversions are inadequately screened.

Fish arriving at high water apparently pass the Stayton maze without serious delay, but later arrivals are delayed or blocked. If the wasteway and power canal route is to be used successfully its fishway must function properly at all times. If this route is not to be used, then sufficient water must be passed through the upper Gardiner Dam fishway to keep the south channel passable, the Stayton Wasteway return should be screened to prevent the entrance of adult fish, and the north channel should be screened to prevent the entrance of downstream migrants. Adequate fish protection at the Stayton channels should in itself greatly increase the returns from both natural and hatchery fish production in the North Santiam River.

The Mill City power diversion dam, 8 feet high, is located 38½ miles above the mouth. The former inadequate fishway was replaced in 1947 with two new fishways through the efforts of the Oregon Fish Commission and Game Commission. The diversion was unscreened at the time of the survey.

A log jam 15 feet high located in a narrow gorge 51 miles upstream near Lakewood was passable with difficulty.

The Detroit dam site is in a narrow gorge approximately 52 miles upstream. The dam, now under construction by the U. S. Army Engineers, will be 259 feet high and will eliminate all anadromous fish production above this point.

Hatchery racks at the confluence of the Breitenbush River, approximately 57 miles upstream, stop all fish in both the Breitenbush and North Santiam Rivers after May of each year.

A bedrock chute and falls 9 feet high located 61 miles upstream is very difficult to pass, and there are several lower falls and cascades in the upper 15 miles.

Domestic sewage and industrial wastes from the towns of Stayton, Mill City, Detroit, and other smaller communities are emptied into the river. The most obnoxious of these pollutants was hot dye-stuff discharged by the Paris woolen mill into the Stayton wasteway where it was observed to drive adult chinook salmon downstream and away from the fish ladder.

There was spawning area available for at least 20,000 salmon below the Detroit dam site, and sufficient area below Stayton to accommodate an additional 10,000 fish if water temperature and flows were more favorable. Above the Detroit dam site there was spawning area in the North Santiam for at least 10,000 salmon. This cooler upper section contains the preferred spawning area, and more than half of the number of salmon in the stream would utilize this area if they were not taken at the hatchery racks at Detroit.

It was estimated from counts made by the survey party that there were at least 1,200 spring chinook spawners in the main stream, of which less than 50 were found below Stayton. In addition, there were nearly 1,000 spawners being held at the Detroit hatchery racks. These fish ascend the river from April through July, and spawn mainly in September. A good run of spring steelhead ascends the river from March through May, spawning for the most part in the upper main stream and its tributaries in May and June. In the year 1940 the hatchery take was 2¼ million steelhead eggs, and it was estimated that there was a run of more than 2,000 fish in the main river.

25S-(2)c. Little North Santiam.--(August 15-16, 1940; Parkhurst and Bryant). Enters the North Santiam River at Mehama, about 28 miles above the mouth. The stream is approximately 30 miles long, of which the lower 15 miles up to the impassable 25-foot high Elkhorn Falls was surveyed. The flow ranges from a minimum of 21 c.f.s., in September to a maximum of 19,400 c.f.s., on November 23, 1942. The water temperature ranged from 61°- 68° F., at the time of observation. The stream gradient is moderate, being 30-40 feet per mile in the lower 20 miles.

The stream flows through a wooded area in a steep canyon. Above the lower 2 miles there are many large, deep, clear resting pools, all of which contained salmon. At a point about 12 miles upstream a narrow resting pool 150 yards long and 10-30 feet deep, locally known as "The Narrows" contained approximately 200 spring chinooks. More than 70 chinooks were counted in the pool at the foot of Elkhorn Falls. Spring chinook salmon reach these pools during spring high water. Because of the low summer flows fish are confined to some of these pools until the first fall rains, when they move onto the spawning riffles. There is spawning area available below the falls for at least 2,500 salmon, but most of the spawning occurs above the lower 5 miles. The area above the falls should be surveyed, as a fish ladder at the falls seemed desirable. It was estimated that there were at least 500 spring chinook spawners in the stream, and a good spring run of steelhead was reported. None of the lower tributaries were of appreciable value to spawning salmon.

25S-(2)i. Blowout Creek.--(July 18, 1938; Parkhurst.) Enters the North Santiam approximately 56 miles above the mouth. The stream is about 12 miles long, of which the lower 2 miles were surveyed to a series of impassable cascades and low falls in a box canyon. The water temperature was 53° F. The stream gradient is fairly steep. There is spawning area available for approximately 200 fish. A few steelhead were reported to enter the stream.

25S-(2)j. Breitenbush River.--(September 27-29, 1938; Hanavan, Lobell, Baltzo, and Kolloen.) Enters the North Santiam approximately 57 miles above the mouth. The stream is 13½ miles long to the confluence of the North and South Forks, and was all surveyed. The flow ranges from a minimum of 87 c.f.s., on September 2, 1940, to a maximum of 9,710 c.f.s., on November 23, 1942. The water temperature ranged from 46°-51°F.

The stream gradient is fairly steep. At points 13 and 13½ miles upstream there are 2 small 4- to 5-foot high power dams supplying local resorts. The downstream aprons and the addition of flash boards to these dams make them impassable at low water. There is spawning area for at least 3,000 fish below the dams, and for several hundred additional fish in the main stream above.

In the years before hatchery racks were installed at the mouth of the stream and before the small power dams were built there were excellent runs of spring chinook salmon and even larger runs of steelhead into the Breitenbush and its two forks. The last big run of steelhead was reported in 1934. The entire Breitenbush stream system will be rendered inaccessible to anadromous fish by the Detroit Dam.

25S-(2)j-i. North Fork Breitenbush River.--(July 18, 1938; Parkhurst and Wilding.) The stream is 10 miles long, of which 6½ miles were surveyed. The discharge was 72 c.f.s., at the time of observation. The water temperature was 54° F. The stream gradient is fairly steep. The lower 5-mile section has an interlacing channel system with spawning area for more than 2,000 salmon. The stream formerly supported good runs of both salmon and steelhead.

25S-(2)j-ii. South Fork, Breitenbush River.--(July 14-15, 1938; Parkhurst and Wilding.) The stream is 8 miles long, of which the lower 1.7 miles were surveyed up to an impassable 12-foot high falls. The stream is fed by glaciers on Mt. Jefferson and was discharging 106 c.f.s. The gradient is steep throughout. There was spawning area available for at least 1,000 fish. Good runs of salmon and steelhead formerly entered the stream.

25S-(2)l. Pamelia Creek.--(Inspected September 27, 1937; Hanavan.) The stream is about 7 miles long. It arises from glaciers on Mt. Jefferson, and was discharging 130 c.f.s. The water temperature was 45° F. The gradient is steep, the stream having many cascades and a few log jams. There is spawning area for a few hundred salmon. A few chinook salmon and steelhead utilize the spawning area particularly in the lower mile.

25S-(2)m. Marion Fork.--(September 24, 1937; Balazo and Kolloen.) Enters the North Santiam approximately 75 miles above the mouth. The stream is 7 miles long, of which 3½ miles were surveyed up to impassable 40-foot high Gatch Falls. The discharge was 120 c.f.s., and the water temperature was 48° F. The stream gradient is steep for most of the course. The stream forms a network of interlacing channels near the mouth, and contains spawning area for at least 1,500 salmon. Former runs of spring chinook and steelhead have been intercepted in recent years by the hatchery racks on the main Santiam.

25S-(3). South Santiam River.--(Lower 35 miles surveyed August 4-5, 1940: Frey and Zimmer. Next 29½ miles surveyed September 15-17; Hanavan, Kolloen, Baltzo, and Lobell.) Joins the North Fork to form the main Santiam River 11 miles above the mouth. The river is 85 miles long, of which the lower 64½ miles were surveyed. The flow at Waterloo, 24 miles upstream, and above the principal diversions, ranges from a minimum of 96 c.f.s., on September 1-2, 1940, to 70,000 c.f.s., on March 31, 1931. The average yearly discharge is 2,652 c.f.s. The flow from July through October is usually less than 500 c.f.s. The water temperature ranged from 55° - 66° F., with one reading of 74° F., at the mouth of Crabtree Creek. The gradient is slight in the lower 25 miles, moderate in the next 30 miles, and steeper in the upper section.

There is a paper mill diversion dam 4 feet high at the town of Lebanon, 19 miles above the mouth. This dam is equipped with a fishway which was nearly dry and impassable at the time of the survey. The diversion is unscreened except for a trash rack. Between the diversion take-off at the dam and the return 500 yards below the river channel was practically dry. Part of the diverted water does not return to the Santiam, but flows into the Albany Ditch. From the diversion return to the mouth of the river the stream was highly polluted with paper mill waste and sewage from the town of Lebanon. The water in this section was dark and foul and the stream bed was covered with a scum of gelatinous material. A chemical analysis of the water taken at a point 9 miles above the mouth indicated no dissolved oxygen present. Numerous dead rough fish littered the shore.

There is a 9-foot high concrete power and irrigation diversion dam located about 2½ miles farther upstream. The dam was equipped with a fishway which was nearly dry and impassable at the time of the survey. The power company, working in cooperation with the Oregon Fish Commission and Game Commission, recently has completed a new concrete fishway over this dam. The diversion canal, known as the Lebanon Ditch, was carrying 160 c.f.s., but withdraws at times a maximum of 346 c.f.s. Most of this diversion is not returned to the Santiam, but flows into the Albany Ditch leading to the Mountain States Power Company plant near the mouth of the Calapooya River at Albany.

There is a series of low falls 3-6 feet high 43 to 45 miles above the mouth, and a 5-foot falls 54½ miles above the mouth. These falls are very difficult or impassable at low water. There is an impassable falls 64 miles above the mouth and another, 20 feet in height, 65 miles upstream, at which point the survey was terminated.

There is spawning area for about 20,000 salmon in the South Fork above Lebanon. Apparently the major part of the present run spawns 35 to 65 miles above the mouth. In the year 1937, 237 spring chinooks were observed spawning above the town of Sweet Home, and numerous redds indicated the presence of many uncounted fish. Fortunately, a sufficient

number of salmon are able to pass the critical stream section below Lebanon at high water stages in order to maintain the present runs into the upper river section and tributaries. However, the fate of many of the downstream migrants is subject to question. Chubs, suckers, and minnows were abundant in the lower and middle sections, and small cutthroat and rainbow trout and a few whitefish were observed in the upper section. None of the tributaries above the confluence of the Middle Fork have been surveyed.

25S-(3)a. Thomas Creek.--(Lower 18½ miles to Jordan Dam inspected August 18-20, 1940; Parkhurst and Bryant. Next 8½ miles surveyed September 26-27, 1945; Brewington, Davis, and Johanson.)

Enters the South Santiam 3 miles above the mouth, and is about 47 miles long. The discharge on August 18, 1940 was about 20 c.f.s., and the water temperature ranged from 67° - 71° F. The gradient is slight to moderate (25-45 feet per mile).

A diversion dam 6 feet high at the town of Scio, 9 miles above the mouth, provides power for a feed mill. The former fishway was impassable at low water, and recently was replaced. The diversion is unscreened.

The Jordan power dam, located approximately 18½ miles above the mouth, is 15 feet high. The fishway was completely broken down and the dam was a total barrier at the time of the survey. However, in recent negotiations between the Mountain States Power Company and the Oregon Fish Commission and Game Commission, plans have been prepared for a new fishway at this dam. The power diversion amounted to 15 c.f.s., and was returned to the stream at the tailrace of the power plant one mile below. The diversion flume is unscreened at the take-off, but there is a 1/2 inch spaced bar screen just above the power house. The by-pass at this point was dry. The power plant operates under a 56 foot head at 900 R.P.M. The river channel in the 1-mile section between the dam and the power plant return was practically dry except for isolated pools. The fishway at Jordan Dam recently has been repaired.

There is a 3-foot high dam 2¼ miles above Jordan Dam that is a barrier at low water, as is a similar structure 1¼ miles farther upstream.

The lower 16 miles of the stream is heavily silted and the next 2½ miles contain a large amount of bedrock and boulders. There is some spawning area below Jordan Dam, but due to silting, high temperatures, and low flows it is not utilized by salmon or trout. There are good spawning areas above Jordan Dam, sufficient to accommodate an estimated 4,000 salmon in the 8-mile section surveyed. The water temperature in this upper section ranged from 49° - 54° F. The present runs of both salmon and steelhead have been greatly depleted.

Burmester Creek.--(10 c.f.s.) and its tributary Bilyeu Creek (5 c.f.s.) entering 1½ miles below Jordan Dam, have large amounts of bedrock and boulders in the stream bed and are of little value to salmon, but may be of some value to steelhead. Jordan Creek, entering 1/2 mile above the dam, was discharging less than 1 c.f.s., and was considered to be of no value to salmon.

25S-(3)b. Crabtree Creek.--(August 16-21, 1940; Frey and Zimmer.) Enters the South Santiam 4 miles above the mouth. The stream is about 43 miles long, of which the lower 33 miles were surveyed. The flow at a point 13 miles above the mouth was 38 c.f.s. The gradient is slight to moderate, and the water temperature ranged from 58 - 70° F.

A water wheel at an old mill just above the confluence of Roaring Creek, 19½ miles above the mouth, is a barrier at low water, as is a log jam 1/4 mile above. An irrigation diversion located 1/2 mile above the mouth of Roaring Creek and carrying 4 c.f.s., is unscreened. A diversion ditch leading to the Snow Peak Logging Company mill pond 24 miles above the mouth is unscreened. The Lacomb irrigation ditch located 25 miles upstream and carrying 5 c.f.s., is equipped with screens.

There is spawning area in the lower 19½ miles below the old mill wheel for about 4,000 salmon, but the run of salmon passes to the preferred cooler upper section of the stream during high water stages. In the remaining 13 miles surveyed there is spawning area for at least 1,000 salmon, although it occurs in scattered patches among boulders and bedrock.

There were 155 spring chinook spawners counted in the vicinity of Roaring Creek and above, and some salmon are reported to also enter some of the upper tributaries including Bald Peter, South Fork, and Rock Creeks. A few steelhead also enter the stream, and rough fish are abundant in the lower section.

25S-(3) b-ii. Roaring Creek.—(Inspected August 22, 1940, Zimmer; and September 3, 1945, Parkhurst.) Enters Crabtree Creek 19½ miles above the mouth. The stream is about 7 miles long, and was discharging 15 c.f.s. There is a dam 3 feet high located 200 yards above the mouth and equipped with a fish ladder. An Oregon State trout hatchery is located a short distance above the mouth and diverts 6½ c.f.s. Roaring Creek has a steep gradient and little suitable spawning area. Steelhead trout have been reported occasionally, but no salmon have been seen above the dam.

25S-(3)e. Wiley Creek.—(Inspected September 2, 1945; Parkhurst and Manavan.) Enters the South Santiam at the town of Foster, about 40 miles above the mouth. The stream was flowing 8 c.f.s., and the water temperature was 63° F., at a point 1 mile upstream. A concrete dam

30 feet high located at the mouth creates a lumber mill log pond. The dam is provided with a poor fish ladder, which was impassable at the time of observation. The stream is of little possible value to salmon.

25S-(3)f. Middle (Fork) Santiam River.—(September 18-21, 1937; Baltzo and Kolloen. July 10-13, 1938; Parkhurst and Wilding.) Enters the South Santiam approximately 42 miles above the mouth. The stream is about 30 miles long, of which the lower 19 miles were surveyed. The flow ranged from a minimum of 54 c.f.s., on December 1, 1936, to a maximum of 33,500 c.f.s., on December 31, 1942, from records of the U.S.G.S. taken at a station about 7 miles above the mouth. The water temperature in September 1937 was 58°-62° F.

The only obstruction to the passage of fish is the rack of the Oregon State salmon hatchery located about 2½ miles upstream. The rack is installed in May and removed in October. All chinook salmon ascending the stream are taken at this point for artificial propagation except for a few that ascend at higher water before the rack is installed.

The stream gradient is moderate to fairly steep, 50-100 feet per mile. There are numerous good spawning areas and resting pools well distributed throughout the course. There is spawning area for at least 15,000 salmon in the stream. None of the tributaries except Quartzville Creek are of significant value to salmon because of their steep gradients. In September, 1937, 24 spring chinook spawners were counted below the racks, 250 were being held between the racks, and 40 were counted on spawning riffles above. A fair run of steelhead trout ascends during spring high water, before the racks are installed.

25S-(3)f-iv. Quartzville Creek.—(September 18-22, 1937; Baltzo and Kolloen. July 13, 1938; Parkhurst and Wilding.) Enters the MiddleSantiam approximately 7½ miles above the mouth. The stream is about 26 miles long, of which the lower 16 miles were surveyed up to an impassable 20 foot falls. In September 1937 the discharge was 35 c.f.s., and the water temperature was 67° F. The stream course extends through a canyon in a heavily forested, mountainous area. The gradient is moderate in the lower 4 miles and becomes fairly steep upstream. Between 9½ miles and 13½ miles upstream there are three falls, 10, 7½, and 6 feet high that are impassable at low water. Another low water barrier is formed by a lava sink area 13 miles upstream where the channel is nearly dry in summer. A 4-foot falls a short distance above is also a low water barrier, and no salmon were seen above this point. There is spawning area available for at least 3,000 salmon. There were 115 spring chinooks observed spawning in September 1937, these fish apparently having passed the hatchery rack site on the Middle Fork before the racks were installed. The tributaries are small and steep, and are considered to be of little value to salmon. Yellowstone, Boulder, and Canal Creeks, discharging 5-8 c.f.s., may be of some slight value, particularly for steelhead and resident trout.

25T-U. Second Periwinkle Creek and First Periwinkle Creek are both small streams on the Willamette Valley floor and entering the Willamette River between the Santiam and Calapooya Rivers. Neither of them is of value to salmon.

25V. Calapooya River.--(Lower 26 miles inspected and the next 20 miles surveyed September 1-2, 1945; Parkhurst, Hanavan, Silliman, Rucker, and Brewington. Next 13 miles to North Fork surveyed, September 29 - October 2, 1941; Frey and Bryant.) Enters the Willamette River approximately 114 miles above the mouth. The stream is about 65 miles long. The flow at a point 34 miles upstream ranged from a minimum of 13 c.f.s., on September 8, 1940, to a maximum of 9,400 c.f.s., on December 31, 1942. The stream gradient is slight in the lower 26 miles, and moderate above. The water temperature was 72° F., in the lower 26 miles, 58-66° F., in the next 20 miles, and 47-51° F., in the upper section.

The Albany Ditch, leading from the South Santiam River, discharges through the Mountain States Power Plant 1/2 mile above the mouth. The power plant operates under a 36-foot head, and chinook salmon have been reported taken from the tailrace.

A diversion dam 4 feet high located 21 miles upstream was diverting 18 c.f.s., to a woolen mill at Brownsville, and the diversion is unscreened. A fishway over the dam is impassable at low water.

The Finley Mill Dam at Crawfordsville, 26 miles above the mouth, is 10 feet high and is a barrier except at extreme high water stages. At least 20 chinook spawners were observed to be held up below the dam in September, 1945. In 1941 a few salmon were reported to have passed to the upper watershed when part of the dam was temporarily washed out. This dam, although not in use, has prevented the passage of chinook salmon to the major spawning areas and is largely responsible for the depleted condition of the run in the Calapooya River.

A series of cascades and rapids about 30 miles upstream and two log jams 37 and 42 miles above the mouth were believed passable. A log pond dam at Dollar, 48 miles upstream, was a low water barrier in 1941, but was reported to have washed out in 1945. A log jam over a low falls 54 miles upstream was a total barrier.

The lower 25 miles of the stream has a mud bottom and is of no value to salmon. There is 1 mile of good spawning area below the Finley Mill Dam, containing suitable spawning area for approximately 1,000 salmon. There is spawning area for at least 9,000 additional fish from the Finley Dam to the impassable log jam 27 miles above.

The present run of salmon is very small, probably less than 100 fish, although in 1941 more than 200 spring chinook spawners were reported. Steelhead trout were reported as far upstream as the impassable

Figure 6.-- Sawmill dam near the mouth of Mary's River, at Corvallis, Oregon; an obstruction to migratory fish.

log jam above Dollar, although they have great difficulty in passing the Finley Mill Dam.

There are numerous small, steep tributaries, none of which are believed to be of any value to salmon spawners, with the possible exception of Brush Creek, which enters at Crawfordsville, was discharging 6 c.f.s., and may have a small amount of spawning area.

25W-Y. Bowers Slough, Dead River (and Owl Creek), and Dixon Creek are all small streams on the Willamette Valley floor and entering the Willamette River between the Calapooya and Marys River. None of them are of value to salmon.

25Z. Marys River.--(Inspected August 30, 1945; Parkhurst, Hanavan, Silliman, and Brewington.) Enters the Willamette River approximately 127 miles above the mouth, at Corvallis, Oregon. The stream is about 40 miles long, rising in the Coast Range. The flow near Philomath, about 10 miles upstream, ranged from a minimum of 6 c.f.s., on September 12-13, 1944 to a maximum of 7,720 c.f.s., on January 1, 1943. The stream is extremely low during the summer.

A lumber mill dam just above the mouth is 4 feet high with an apron extending 34 feet downstream, and is impassable at low water. The stream is polluted by sawmill waste in the vicinity of the dam.

The gradient is slight in the lower 15 miles and the stream bed is composed of mud and clay. In the upper hilly section the stream bed is composed mainly of bedrock or large rubble and silt. Due to the general lack of spawning area the stream is of little possible value to salmon, and no salmon have been reported.

25AA. Muddy Creek.--Enters the Willamette River via East Channel approximately 129 miles above the mouth. The stream is about 25 miles long, and meanders across the Willamette Valley floor. The stream bed is composed mainly of mud and silt. Since it is of no value to salmon it was not surveyed.

25BB. Long Tom River.--(Inspected June 11-13, 1938; Parkhurst and Wilding.) Enters the Willamette River approximately 140 miles above the mouth. The stream is about 48 miles long. The stream is blocked by the 35 foot high Fern Ridge flood control dam completed by the U. S. Army Engineers in 1942, and located 15 miles upstream. The stream bed below the dam consists mainly of mud and silt, and is valueless to migratory fish. In this section the gradient is slight and summer water temperatures are high. Before the dam was built the minimum discharge was 7 c.f.s., and since regulation it is occasionally zero at the dam. The maximum recorded discharge was 19,300 c.f.s., on January 2, 1943.

No facilities are provided for the passage of fish at the dam as the stream never was of any value for anadromous fish.

25CC. Canterbury Creek.—Enters the Willamette approximately 167½ miles above the mouth, 1½ miles downstream from the mouth of the McKenzie River. It is 4 miles long, and in reality is a small, lower side channel of the McKenzie, winding northward near the town of Colburg. It was not surveyed.

25DD. McKenzie River.—(August 21-25, 1937, June 12-13, 1938; Hanavan, Baltzo, Kolloen, Parkhurst, Wilding, Lobell, and Langton.) Enters the Willamette River approximately 169 miles above the mouth. It is 86 miles long, of which 82 miles were surveyed to the impassable 35-foot high Tamolitsh Falls. The McKenzie rises high in the Cascade Range and is abundantly supplied with water throughout the year from melting snow accumulations and springs. Its drainage area is more than 1,300 square miles. Near Vida, Oregon, or 42 miles upstream, the minimum recorded flow was 1,260 c.f.s., on November 7, 1930, September 13, October 4, 8, and 9, 1931. The maximum estimated flow was 60,000 c.f.s., in the flood of January 6, 1923. The water temperature ranged from 44 to 54° F., but temperatures up to 70° F., are known to have occurred in some years. The stream gradient is moderate in the lower 62 miles, increasing gradually above. For the most part the river extends through a mountainous, wooded section, and a large volume of spring water aids in maintaining a moderate water temperature throughout the year.

The Walterville Power Canal takes off 25 miles above the mouth, has a capacity of 80-1000 c.f.s., and is unscreened. It leads to the Eugene Municipal Power Plant several miles below, and returns to the river 17 miles above the mouth. In recent years the Oregon State fish hatchery racks have been installed in the McKenzie a short distance above this point, and a large number of adult chinook salmon have entered the Walterville Canal, where there was considerable mortality. Since 1947 the power canal return also has been racked to prevent salmon from entering.

The Leaburgh (Vida) Power Dam, located 37½ miles above the mouth, is 15 feet high, and is equipped with two efficient fishways. The power canal has a capacity of 1,000 c.f.s., and the only fish protective device is a slow moving arrangement of suspended chains that does not appear to be effective in barring fingerlings from the diversion. The possible destruction of fingerlings at the power house should be investigated as more adequate screens may be required.

There is sufficient spawning area in the entire river for at least 80,000 chinook salmon. Of this potential total, spawning area for approximately 50,000 fish is located above the Oregon State hatchery racks near Hendricks bridge, and can be utilized only by those fish allowed to pass through the racks. In recent years one-third to one-half the run has been passed above the racks. The Oregon Fish Commission estimated the total spring chinook run into the McKenzie River in 1947 to be 4,780 fish. Spawning has been observed throughout the main river and in several of the larger tributaries, usually occurring in September.

No other species of salmon or any steelhead trout are found in the McKenzie. Squawfish, suckers, and cyprinids are fairly abundant in the lower reaches. The resident variety of rainbow trout, locally called "Redsides" is nationally famous as a sport fish. Special McKenzie River boats have been developed for the spectacular white-water fishing trips down the McKenzie for this brilliantly colored fish. Thus, in addition to its salmon production, the McKenzie has an extremely high recreational value. Largely because of the recognition of the fishery values, the former plan for a high flood control dam on the main McKenzie at Quartz Creek has been abandoned and in its place a plan involving dams on three tributaries of the McKenzie has been adopted.

In the past the McKenzie River was the most important spring chinook salmon producer in the Willamette River system. Its great potential value for both salmon and trout should be safeguarded and developed.

25DD-(1). Mohawk Creek.--(June 19-21, 1938; Hanavan, Parkhurst, Wilding, Morton, and Langton.) Enters the McKenzie River approximately 10 miles above the mouth. The stream is about 30 miles long, of which the lower 20 miles up to an impassable 12-foot high falls was surveyed.

The flow ranged from a minimum of 11 c.f.s., on September 17, 1938 to a maximum of 8,160 c.f.s., on January 1, 1943. From July through October the discharge is usually 25-50 c.f.s., (U.S.G.S. records). The water temperature was from 60-64° F. In the lower 9 miles to Marcola, Oregon the valley is flat, well cultivated, and the gradient is only 8 feet per mile. In the next 9 miles above Marcola the stream is bordered by steep hills and the gradient is 28 feet per mile. The gradient above this point is increasingly steep, with cascades and low falls. The upper watershed consists of completely logged-off, burned-over, denuded hills. Because of this there are extreme variations in water level, with floods rising up to 15 feet over a short period. The farmlands in the lower section suffer from flooding and occasional soil losses due to bank cutting. Below Marcola the stream bed is over 50 percent mud and sand, and the spawning gravels are heavily silted. The stream is bordered by thick marginal vegetation throughout, which affords some shelter for resident trout. Resting pools are numerous below Marcola, but the better spawning riffles are located above. There is spawning area available for about 4,000 salmon. It was reported that the stream supported a run of spring chinook salmon up to about the year 1910, but this run has been greatly depleted, and there are no reports of runs of migratory fish at present.

The lower section of the stream abounds with chubs, suckers, minnows, and turtles. A few cutthroat trout were seen in the upper section.

The principal tributaries are McGowan, Parsons, Mill, Cash, and Shotgun Creeks, each of which had observed discharges of 5-10 c.f.s. All other tributaries were carrying less than 3 c.f.s., at the time of the survey.

25DD-(2). Camp Creek.--(June 19, 1938; Hanavan, Morton, and Langton.) Enters the McKenzie River approximately 17 miles above the mouth. The stream is about 9 miles long, of which 7.8 miles were surveyed. The lower portion of the stream is 20-25 feet wide, and flows sluggishly between dirt and brush covered banks 6-12 feet high in a mile wide valley. This lower section of the stream is muddy and silt covered, and lacks spawning area. The upper portion of the watershed is in fairly high, brushy, logged-off hills. The entire river is full of fallen logs and brush piles, often forming 2-4 foot falls in the middle portion of the stream course. The upper 1½ miles surveyed includes a series of 2-foot falls and cascades, and a 5-foot falls dropping on a wide rock apron forms a barrier at the upper terminus of the survey.

A 7-foot lumber mill dam 3 miles above the mouth is impassable when the mill is operating, as is a 6-foot mill dam a mile above. A temporary mill dam 7 miles above the mouth would also be impassable when in use.

This stream appears to have no value to salmon, and no runs have been reported. Except for cyprinids in the lower portion and a few small cutthroat in the upper portion the stream is generally barren of fish.

25DD-(3) to (7). Johnson Creek, Ritchie Creek, Trout Creek, Hatchery Creek, and Indian Creek are small 3 to 4 mile long tributaries entering the McKenzie between Hendricks Bridge and Vida, Oregon. These streams were believed to have little if any value to salmon, and were not surveyed.

25DD-(8). Gate Creek.--(June 6 and July 22, 1938; Parkhurst and Wilding.) Enters the McKenzie River approximately 38 miles above the mouth. The stream is 2.2 miles long to the confluence of the North and South Forks. It is 25-40 feet in width, had an estimated discharge of 35 c.f.s., and the water temperature was 66° F., on July 22. The narrow valley is little cultivated, and is bordered by forested hills. The banks are steep and rocky, and marginal vegetation is dense. The gradient is moderate, with good pools and riffles.

A run of spring chinook is intercepted at the Oregon State hatchery racks on the main McKenzie. A series of hatchery rearing ponds for spring chinook are formed by weirs in the creek 1/2 mile above the mouth. Recently liberated fingerlings 3-4 inches in length were numerous below this point.

There is good spawning area for at least 1,000 fish up to the forks.

25DD-(8)a,b. The North and South Forks are each about 7 miles long and had discharges of 15 c.f.s. The considerable amount of large rubble in each limits the spawning area. The North Fork was surveyed for a distance of 2.6 miles, and contains potential spawning area for approximately 250 salmon. On the South Fork at a point 0.7 mile above the mouth there is a bedrock chute with a shallow 4-foot drop that is normally a barrier. Below this falls there is spawning area for less than 100 salmon.

25DD-(9) to (14). Martin Creek, Bear Creek, Deer Creek, Ennis Creek, Quartz Creek, and Elk Creek.--entering the McKenzie between Gate Creek and Blue River did not appear to be good salmon streams, and were not surveyed. These are all 3-6 miles long, with the exception of Quartz Creek, which is 12 miles long and has a high percent of large rubble and boulders.

25DD-(15) Blue River.--(August 15-17, 1937; Baltzo and Kolloen.) Enters the McKenzie River approximately 55 miles above the mouth. The stream is about 16 miles long, of which the lower 11 miles were surveyed. The discharge was 53 c.f.s. The minimum recorded flow was 13 c.f.s., on September 27, 28 and October 1, 2, 1938. The maximum recorded flow was 8,020 c.f.s., on December 31, 1942. The flow from July through October is usually 20-75 c.f.s. (U. S.G.S. records). The gradient is fairly steep in the lower mile, moderate in the next 5 miles where the valley widens, and becomes increasingly steep in the upper section. Except for the one slightly wider section, the valley is narrow and the walls are steep and heavily wooded. The water temperature was 58-62° F.

A 9-foot falls located 2½ miles above the mouth is impassable except at flood stages. Numerous low falls above the lower 6 miles are passable only with difficulty.

A large part of the stream bed is composed of large rubble, boulders, and occasional patches of bedrock. The gravel of suitable size for spawning is so evenly distributed throughout the larger material that much of it cannot be utilized to its fullest extent. Good riffles are scarce, and the only good spawning areas are located at the lower ends of the numerous large resting pools. Many of these large, deep pools are excellent for holding spring chinook salmon through the summer. There is potential spawning area available for at least 2,000 salmon. Old residents reported that large salmon formerly entered the stream. In more recent years only a portion of the salmon allowed to pass the racks on the main McKenzie ascend to the Blue River. Rainbow trout of good size were numerous in the upper section of the river.

There are several small tributaries to Blue River which may contain some additional salmon spawning area. Simmonds Creek, entering 1½ miles above the mouth, is about 4 miles long and was discharging about 2 c.f.s. The North Fork, entering approximately 2 miles upstream, is about 5 miles long and has a small tributary, Quartz Creek entering 1/2 mile upstream. The North Fork was discharging 3.6 c.f.s., the temperature was 60° F., the gradient is moderate to fairly steep, and contains considerable large rubble and bedrock. Trout utilize this stream during the spring, but drop back into Blue River during the summer low water period. Lookout Creek, entering 5½ miles upstream, is formed by the confluence of McRae and Mack Creeks and is 3½ miles long. It was discharging 24 c.f.s., the temperature was 56-58°F., and the gradient is fairly steep. Three 6-9 foot falls in the lower 1½ miles are impassable at low water. Spawning area is limited because of a high percentage of large rubble and the stream could accommodate only a few salmon. A large number of small rainbow trout were observed. Mona Creek, entering 400 yards farther upstream, had a flow of 2 c.f.s. Tidbits Creek, 6½ miles upstream, had a flow of 8 c.f.s. Cook Creek, at the upper end of the survey, had a flow of 3 c.f.s.

25DD-(16). South Fork, McKenzie River.--(August 15-19, 1937, and July 20, 1938; Hanavan and Langton.) Enters the McKenzie River approximately 58 miles above the mouth. The stream is 30 miles long, of which the lower 26 miles were surveyed. River flows were as follows: 300 c.f.s., at the mouth; 165 c.f.s., below Roaring River, 20½ miles upstream; 110 c.f.s., at Frissel Crossing, just above; and 40 c.f.s., at the upper end of the survey. The water temperature was 53° F., in the lower 7½ miles, and was 46° F., at the upper end of the survey on July 20, 1938. The gradient in the lower 15 miles was estimated 50-60 feet per mile, and in the next 11 miles was 70-100 feet per mile.

The lower 2½ miles of the river flows through a heavily wooded and swampy flood plain, entering the McKenzie through several channels. Multiple channels are common along most of the course. The remainder of the watershed is mountainous and densely forested, the river valley being narrow and often canyonous.

The only obstructions found in the stream were two difficult log jams; the first 23½ miles above the mouth, and the second 300 yards farther upstream.

Large, well sheltered resting pools are fairly numerous throughout. The best spawning areas appear to be in the secondary channels between Dutch Oven Camp and Frissel Crossing, 15-20 miles upstream, where there are long sections of uniformly small gravel. There is spawning area available for at least 13,000 salmon. However, only a small portion of the salmon spawning area is utilized. The survey party observed 30-40 adult spring chinooks in a large resting pool 7 miles above the mouth. These fish had escaped from the Oregon hatchery

racks on the main McKenzie when the racks washed out during a spring freshet. Fair numbers of small chinook fingerlings were observed in the lower section. Rainbow trout fishing was reported to be only fair because of intensive fishing due to easy accessibility from a road paralleling most of the stream. Suckers were abundant in the lower few miles.

Except for the following six creeks which were surveyed in detail, all other tributaries to the South Fork are steep, discharging less than 3 c.f.s., and are of little possible value to salmon.

25DD-(16)a. East Fork of the South Fork, McKenzie River.--(July 21, 1938; Hanavan.) Enters the South Fork approximately 6 miles above the mouth, and is 9 miles long. The lower 2 miles was surveyed to an impassable log jam and series of 5 falls. The stream was 18 feet wide, flowing 10 c.f.s., and the water temperature was 61° F. It is confined to a narrow, steep canyon, and is not suitable for salmon spawning because of numerous cascades and low falls and lack of suitable spawning area. Numerous small trout were seen.

25DD-(16)b. French Pete Creek.--(July 21, 1938; Wilding.) Enters the South Fork 10.3 miles above the mouth, and is 11 miles long, of which 1.2 miles were surveyed to a series of 4-5 foot high impassable falls. The stream was 21 feet wide, flowing 8 c.f.s., and the water temperature was 60°F. The stream is steep, being largely a succession of cascades and low falls. The stream bed is composed of 78 percent large rubble, lacks spawning area, and is therefore of little value to salmon.

25DD-(16)c. Hardy Creek.--Enters the South Fork 11 miles above the mouth, and is 4 miles long. It was discharging about 5 c.f.s., on July 21, 1938, and may contain a small amount of spawning area. It was not surveyed.

25DD-(16)d. Augusta Creek.--(July 20, 1938; Morton.) Enters the South Fork 15 miles above the mouth, and is 8 miles long, of which the lower 2 miles were surveyed. The stream was 18 feet wide, flowing 7 c.f.s., and the water temperature was 60-62°F. The gradient is moderate to fairly steep. Bedrock and large rubble predominate in the stream bed, and there is little spawning area. Three bad log jams, 10-15 feet high, were found. Small rainbow trout were fairly numerous, and one jack salmon was seen.

25DD-(16)e. Roaring River.--Enters the South Fork 20½ miles above the mouth, and is 6 miles long. It was discharging 55 c.f.s., on July 20, 1938, and is similar to Elk Creek.

25DD-(16)f. Elk Creek.--(July 20, 1938; Wilding.) Enters the South Fork 23 miles above the mouth, and is 7 miles long, of which 0.6 mile was surveyed. The stream was 25 feet wide, flowing 25-30 c.f.s., and the water temperature was 52° F. It has steep, rocky banks, and is

mainly a succession of cascades, low falls, and small pools. Although large rubble predominates, there is spawning area available for a few fish. No salmon were seen, but trout were fairly numerous.

25DD-(17) Horse Creek.--(August 24-26, 1937, and July 22, 1938; Baltzo, Kolloen and Parkhurst.) Enters the McKenzie River 64 miles above the mouth, and is 22 miles long. The lower 11 miles to Separation Creek, its principal tributary, was surveyed in 1937, and the next 4 miles to Mosquito Creek was surveyed in 1938. The flow near the mouth was 332 c.f.s., and at the mouth of Roney Creek, 13 miles upstream, was 39 c.f.s. The water temperature was 50-58°F. The gradient in the lower 7 miles is moderate, increasing to more than 100 feet per mile above. In the lower 2½ miles Horse Creek flows through flat bottom lands 2-3 miles wide in an intricate network of cross connecting channels that shift with each high water period. The earth banks are low, and the stream is overhung with a jungle-like growth of trees and brush, affording good shelter for fish. This lower section is flooded during high water periods. Multiple channels also occur in the next 3 miles upstream as the valley narrows to 1/4-1/2 mile. The upper watershed is a mountainous, wooded (conifers) section. Above Separation Creek there are many fast riffles and cascades and a high percentage of large rubble. The Forest Service reported that the stream widens in the upper section and originates in a swampy, flat, area containing two small lakes. The only barrier found in the stream was an impassable log jam 1 mile above Separation Creek. There are 12-19 good resting pools per mile. There is sufficient spawning area available for several thousand chinook salmon, but it is little used at present. Seven adult chinooks were seen in 1937 and about 100 in 1938,these fish having escaped from the McKenzie River racks.

Local residents report that large runs of spring chinooks formerly utilized this stream. Fair numbers of small rainbow and cutthroat trout were observed. The fishing intensity is moderate, the dense brush rendering much of the stream too difficult to fish. Most of the tributaries except Kings Creek, Separation Creek, and Roney Creek are either too small (less than 3 c.f.s.) or too steep to be of value to salmon.

Kings Creek.--Entering 1 mile above the mouth, is 4 miles long, had a flow of 3 c.f.s., and its lower course in a swampy flat is difficult to follow. Roney Creek had a flow of 5 c.f.s., and has some good spawning area near the mouth. Pothole and Mosquito Creeks near the upper end of the survey, each had a flow of 10 c.f.s., but are steep and contain little spawning area.

25DD-(17)b. Separation Creek.--(July 21, 1938; Wilding.) Enters Horse Creek 11 miles above the mouth, and is 13 miles long, of which the lower 2½ miles were surveyed. The stream is 40-50 feet wide at

the mouth, discharging over 200 c.f.s., and is fed by glaciers on South Sister Mountain. The stream is in a narrow valley in rugged, forested, mountainous country, and has a fairly steep gradient. The stream is almost a continuous series of cascades and low falls. Spawning riffles and resting pools are scarce. A log jam and a series of low falls at the upper end of the survey is believed to be impassable. It could support only a few salmon. Two tributaries, Rainbow Creek, flowing 5 c.f.s., and Louise Creek, 40 c.f.s., each having impassable falls near their mouths.

25DD-(18). Lost Creek.--(August 20, 1937, Baltzo.) Enters the McKenzie River 1 mile below Belknap Springs, or 70 miles above the mouth. The stream is nearly 4 miles long. This stream is unusual inasmuch as it has a tributary much larger than itself. It rises in a large spring, 2 acres in extent, at the food of an enormous lava flow in a 1/2 mile wide wooded, flat valley floor. Numerous smaller springs contribute to the flow. The waters of these springs are very clear, as is the 3/4 mile of stream from the source down to the confluence with the White Branch. From this point to the mouth the water is always milky with glacial silt, and only in cold weather is the stream bed visible. Silt is also thickly deposited between large blocks of broken lava in the lower section of the course.

The average stream width was 45 feet, the discharge was 231 c.f.s., and the spring flow above the White Branch was 152 c.f.s., and is fairly constant. The spring water temperature was $44\frac{1}{2}^{\circ}$F. The springs and valley floor are choked with a dense growth of underbrush, ferns, and grasses. The current is uniformly deep and swift throughout the entire course, with pools occurring only in the form of small pockets and eddies along the banks. In spite of the silting and broken lava, there are occasional patches of ideal spawning area, amounting to about 5 percent of the bottom, capable of supporting several hundred spawning salmon.

Old time residents reported that there were formerly heavy runs of spring chinook in Lost Creek in late August, and a few that escape the McKenzie River racks still spawn there every year. One redd and a spent male were observed by the survey party. Other salmon were probably present, but were not seen because of unfavorable observation conditions. Small rainbow trout were numerous in the creek and springs.

25DD-(18)a. White Branch.--(August 20, 1937, Kolloen.) Enters Lost Creek 3 miles above the mouth, and extends for about 15 miles, of which the lower 4 miles were surveyed up to a series of falls 60 feet high. The stream rises at Collins Glacier on Three Sisters Mountain, and is heavily charged with glacial silt. The bottom for the most part is composed of porous lava rock, which causes a large part of the flow to be underground at many places. The discharge was 79 c.f.s., at the mouth

but at a lava sink 4 miles upstream the flow was reduced to 3 c.f.s. The water temperature was 46°F. An 8-foot falls 1 mile above the mouth appears impassable. There is little suitable spawning area. No salmon were observed, and persons familiar with the stream reported that they had never seen or heard of any salmon using it. Neither is it of value as a trout stream.

25DD-(19). Scott Creek.--and 25DD-(20). Boulder Creek, are both small streams entering the McKenzie 71½ and 72 miles above the mouth. They were considered to be of little possible value to salmon, and were not surveyed.

25DD-(21) Deer Creek.--(July 21, 1938; Morton.) Enters the McKenzie 4 miles below the Smith River bridge, or approximately 75 miles above the mouth. The stream is about 8 miles long, of which the lower 2 miles were surveyed. The discharge was 32 c.f.s., and the water temperature 58-59° F. The gradient is moderate, and there is a fair amount of suitable spawning area, sufficient to accommodate about 400 salmon in the section surveyed. However, numerous log jams probably render most of the spawning area inaccessible, and the stream was considered to be of little present value to salmon. Deer Creek is a good trout stream; fingerlings were abundant, and numerous 6-inch and a few 12-inch rainbow trout were seen.

25DD-(22). Olallie Creek.--(July 19, 1938; Langton.) Enters the McKenzie 77 miles above the mouth, and is 2 miles long, originating in two large springs gushing out of a mountain wall. The stream has an average width of 25 feet, and was flowing 70-80 c.f.s. This is one of the coldest streams encountered on the survey, the temperature being 41°F., at the mouth, and 38°F, at the source. It is a typical torrential mountain stream, having a steep gradient and a bed composed chiefly of large rubble. There is little salmon spawning area. No runs have been reported, and it is improbable that salmon ever entered the stream. A few small trout were seen.

25DD-(23). Anderson Creek.--(July 19, 1938; Hanavan.) Enters the McKenzie 1/4 mile above Olallie Creek, and is 6 miles long. The stream was discharging 35-40 c.f.s., and the water temperature was only 44°F. The gradient is steep in the lower 1/2 mile below the road crossing. Above this point the gradient is slight in an open mountain meadow section, and the stream bed is about 80 percent sand. This clear flowing stream is supplied mainly by springs in the mid-section, the upper 3½ miles having an intermittent flow in a lava sink area. Because of lack of suitable spawning area and the prevailing low water temperatures the stream is of little possible value to salmon.

25DD-(24) Smith River.--(July 19, 1938; Hanavan.) Enters the McKenzie 79 miles above the mouth. The stream is 10 miles long, of which the lower 2.6 miles were surveyed. The stream was 25-36 feet wide, and was flowing 18-20 c.f.s., at the upper terminus of the survey.

It flows through a narrow, uninhabited valley in a wooded mountain area. The gradient and the banks are steep, there being many cascades and low falls over large boulders and bedrock. Spawning area occurs for the most part in small patches behind boulders and log jams. The water temperature was 55°F. Although this does not appear to be a very good salmon stream, a few chinooks have been reported utilizing the spawning area in the past few years. At the time of the survey rainbow trout fry and fingerlings were numerous.

25EE. Middle Fork Willamette River.--(Lower 32.5 miles to Lookout Point surveyed June 9-13, 1938 by Hanavan, Parkhurst, Morton, Wilding, and Langton; next 35 miles surveyed August 28 - September 11, 1937 by Hanavan, Baltzo, Kolloen, and Lobell.) Joins the Coast Fork to form the main Willamette River 4 miles above the City of Eugene, Oregon, or approximately 189 miles above the mouth. The stream extends for about 77 miles to its source in Opal, Temanogas, and Indigo Lakes, high in the Cascade Range. U.S.G.S. records show a maximum flow of 55,100 c.f.s., on February 21, 1927, and a minimum flow of 450 c.f.s., on several occasions from September to December at the gaging station 30 miles above the mouth. Severe floods are frequent in the lower section of the watershed. The gradient is moderate except for the headwaters. The water temperature was 48-59°F.

The stream flows through a valley 100 yards to 3/4 mile wide, bounded by high wooded ridges. There is an extensive flood plain area in the lower section where during low water periods there may be as many as five different channels. There are also some multiple channels in the upper section of the stream, due to the formation of log and debris jams. Dense growths of willow, alder, and maple, with some conifers occur along the margins of the stream, and stands of pine dominate the upper drainage area. Farming is practiced only in the lower portion, and is mainly dairy pasturage. There is some domestic pollution in the vicinity of Westfir and Oakridge, Oregon. Some log jams were found in the upper 10 miles surveyed, but all were considered passable.

The Springfield diversion canal, located 2½ miles above the mouth, requires further study.

The Oregon Fish Commission retains salmon racks in the river from May to October at a point about 2 miles above Oakridge, and approximately 41 miles above the mouth. The eggs taken here are propagated at the hatchery on Salmon Creek.

The Oregon Fish Commission (Research Brief, Vol. 1, No. 2.) lists the principal spawning area as being from the Westfir bridge (just below the North Fork, river mile 36) downstream to Duvall Creek (river mile 31). However, in 1937 when the hatchery racks had washed out

the survey party found only 5 fish in this section, but counted 432 spawners in the area from river mile 60 to river mile 68.

There is excellent appearing spawning area in the lower 35 miles. However, only an occasional salmon ever has been observed in this entire section. In the upper 33 miles surveyed there is spawning area for at least 30,000 fish.

The Middle Fork formerly supported a very large run of spring chinooks that spawned mainly in September, but the survey party estimated that there were only about 1,000 natural spawners in the river, in addition to the fish held for artificial propagation.

Meridian Dam, 21 miles above the mouth, now under construction by the U. S. Army Engineers, will be 240 feet high, and will be a total barrier, as there will be no provision for fish passage. This dam will cut off all the salmon spawning area now being used in the entire Middle Fork system except for that in Fall Creek and a few small tributaries below the dam. Extensive plans have been made for handling the runs by means of artificial propagation.

25EE-(1). Hills Creek.--(June 12, 1938; Hanavan.) A small stream about 10 miles long entering the Middle Fork of the Willamette River at the town of Jasper, approximately 8 miles above the mouth. The stream was discharging about 4 c.f.s., and the water temperature was 59°F. About half of the flow is diverted to the Jasper mill, and is returned near the mouth. A bedrock falls at the mouth is impassable at low water. The stream is of no value to salmon.

25EE.-(2). Fall Creek.--(May 20, 1938; Hanavan and Morton.) Enters the Middle Fork, Willamette River, approximately 11 miles above the mouth. The stream branches 3 miles above the mouth, the northerly branch being called Little Fall Creek, and the southerly branch Big Fall Creek. Fall Creek is 100-200 feet wide, and was discharging more than 1,000 c.f.s. The gradient is moderate, although there are some cascades and a 3-foot falls 1¼ miles above the mouth. There is spawning area available for about 2,000 salmon. No salmon were seen by the survey party, but a few spring chinooks are reported to pass through to spawn in Big Fall Creek.

25EE-(2)a. Little Fall Creek.--(June 13-14, 1938; Hanavan and Morton.) Joins Big Fall Creek to form main Fall Creek 3 miles above the mouth of the latter. The stream is approximately 18 miles long, of which the lower 8.3 miles were surveyed up to an old abandoned 25-foot high dam forming a barrier to migratory fish.

In the lower part of its course the stream flows through several cultivated farms. However, the marginal vegetation is dense, and the

entire middle and upper sections of the watershed are within a heavily forested, mountainous area.

The stream was 40-60 feet wide and was discharging 67 c.f.s., at the time of the survey. Recorded discharges range from a minimum of 10 c.f.s., on December 1, 1936, to a maximum of 5,000 c.f.s., on December 31, 1942 (U.S.G.S. Records). From June through December the flow is usually less than 100 c.f.s. The water temperature was 60° F. The gradient is fairly steep, and there are numerous cascades, low falls, and log jams, some of which are barriers at low water stages. There is also an old log dam 4 feet high located 3½ miles above the mouth that is a barrier at low water.

It is estimated that there is suitable spawning area for at least 1,500 salmon in the section surveyed. However, there is no run of salmon into the stream at present. Small runs of silvers and chinooks were reported to have used the stream many years ago. Little Fall Creek retains considerable value for resident trout.

25EE-(2)b. Big Fall Creek.--(May 18-21, June 3-4, 1938; Hanavan, Kolloen, Parkhurst, and Langton.) Joins Little Fall Creek to form main Fall Creek 3 miles above the mouth of the latter. The stream is approximately 27 miles long, of which the lower 21½ miles were surveyed up to an 8-foot high falls that is a barrier to fish at low water.

Throughout the upper 20 miles of its course Big Fall Creek runs through the heavily wooded Cascade National Forest. The stream ranged from a width of 150 feet and a discharge of 163 c.f.s., at the mouth on June 3 to a width of 36 feet and a flow of 41 c.f.s., at the upper terminus of the survey. Records of the U. S. Geological Survey for a station 2½ miles above the mouth show a minimum flow of 19 c.f.s., on December 1, 1936, and a maximum flow of 16,000 c.f.s., on December 31, 1942. From July through October the discharge is usually less than 100 c.f.s. The water temperature was 57° - 64° F., at the time of the survey. The gradient is generally fairly steep, and there are three falls 4 to 8 feet high that are impassable at low water. The lowermost fall, 8 feet in height, is located below the mouth of Andy Creek, or 19½ miles above the mouth. There are numerous large, deep, well protected resting pools, and although the stream bed contains large bedrock outcroppings, there are also extensive potential salmon spawning areas. It is estimated that Big Fall Creek is capable of supporting a population of several thousand spawning salmon. There were no reports or any indications of salmon in Big Fall Creek at present, although it was reported that many years ago the stream supported runs of chinook and silver salmon.

25EE-(2)b-1. Winberry Creek.--(May 18-19, 1938; Hanavan and Langton.) Enters Big Fall Creek 4 miles above the mouth. The main stream is approximately 8 miles long, and was completely surveyed.

It is formed by the confluence of the North and South Forks 8 miles above the mouth. Winberry Creek extends through a steep, 1/2-mile wide valley, draining a mountainous watershed covered with dense fir forests. The stream had an average width of about 50 feet, was discharging 115 c.f.s., and the water temperature was 55° F. The gradient is steep, and there are numerous falls and cascades throughout the course. An 8-foot high falls 4½ miles above the mouth is impassable except at high water. Another falls just below the confluence of the North and South Forks spills over a sloping bedrock apron having a total drop of about 30 feet, and is impassable except possibly at flood stage.

The extremely high percentage of bedrock, boulders, and large rubble, together with the steep gradient renders most of the stream bed unsuitable for salmon spawning. However, the stream could accommodate several hundred spawners, and it was reported that a few spring chinooks enter the stream in September. Cutthroat trout also were reported, and a small number of trout fry were seen.

The chief tributaries are the North Fork, extending about 6 miles and discharging 40 c.f.s., and the South Fork, extending about 9 miles and discharging 60 c.f.s. Since both of these streams enter above impassable falls they were not surveyed.

25EE-(2)b-ii North Fork of Big Fall Creek.--(Not surveyed) Enters Big Fall Creek approximately 11 miles above the mouth. The stream is about 6 miles long. Because of its steep gradient and low summer flow the North Fork was considered of little possible value to salmon. It is of some value to resident trout.

25EE-(2)b-iii Portland Creek.--(May 27, 1938; Hanavan and Langton.) Enters Big Fall Creek approximately 17½ miles above the mouth. The stream is about 7 miles long, of which the lower 1½ miles were surveyed up to two impassable 8-foot high falls. It drains a high, hilly area, partly wooded and partly burned over. The stream had an average width of 30 feet and was discharging 43 c.f.s., which is somewhat greater than the mean flow. The water temperature was 57° F. The gradient is steep, and the stream bed is rough, with numerous cascades. Bedrock and large rubble predominate, and spawning areas are small and scattered. Many log and debris jams were found.

It was estimated that Portland Creek Might accommodate about 200 salmon spawners. However, there were no reports of a run into the stream. It is of some value to resident trout.

25EE-(2)b-iv. Hehe Creek.--(Not surveyed) Enters Big Fall Creek approximately 21 miles above the mouth. It is about 6 miles long, and is a typical, turbulent mountain stream having a steep gradient and a stream bed composed mainly of bedrock and boulders. Hehe Creek is of little possible value to salmon, but is of some value to resident trout.

25EE-(3). Rattlesnake Creek.--(Not surveyed) A small stream about 5 miles long entering the Middle Fork of the Willamette River approximately 11½ miles above the mouth. It is of no value to salmon.

25EE-(4). Lost Creek.--(June 9-10, 1938; Hanavan, Parkhurst, Morton, and Wilding.) Enters the Middle Fork, Willamette River approximately 12½ miles above the mouth. The stream is about 14 miles long, of which the lower 7½ miles up to an impassable lumber mill dam were surveyed.

Throughout most of the section surveyed the stream flows through flat, cultivated valley lands. The gradient in this section is slight, and the stream bed is composed chiefly of mud and silt. The upper portion of the course drains a hilly area covered with a fairly dense growth of fir and hemlock. The flow below the dam at the upper end of the survey was 13 c.f.s. The lower portion of the stream is impassable at low water in some seasons because most of the water is diverted into flumes carrying lumber to the Middle Willamette River. There were three sawmills dumping sawdust, bark, and slashings into the upper section of the stream, where in many places the banks were lined with this accumulated refuse.

There is almost no salmon spawning area in the polluted, mud bottom lower section, and very little in the bedrock covered upper section. A few spring chinook salmon were reported to have entered the stream many years ago, but it is of no present value. Suckers, chubs, minnows, and other rough fish were numerous in the lower section, and a few small trout were reported in the upper section.

25EE-(5). North Fork of Middle Fork Willamette.--(August 1, 1937, and July 11-15, 1938; Hanavan, Kolloen, Morton, and Langton.) Enters the Middle Fork of the Willamette approximately 36 miles above the mouth. The stream is about 46 miles long, of which the lower 37 miles to Skookum Creek were surveyed. Gaging records of the U. S. Geological Survey for the water year 1944-45 taken at a station 1 mile above the mouth show a minimum flow of 101 c.f.s., in October and a maximum flow of 6,850 c.f.s., in February. However, an unprecedented flood discharging an estimated 20,000 c.f.s., has been known to occur. The water temperature ranged from 54° to 64° F.

The North Fork extends through a narrow valley bordered by high hills. The lower and middle sections of the watershed have been logged, and logging operations are now extending into the virgin conifer forests of the upper, mountainous section. However, a good second growth is occurring in the older logged-off area in the lower section. Forest fires have laid waste a large section of the upper watershed, thus adding to the danger of flash floods. There is practically no cultivation of the area, the principal activities being logging and lumbering.

The stream gradient is moderate throughout almost the entire section surveyed and there are extensive suitable salmon spawning areas. The middle portion of the river from the mouth of Christy Creek to Brock Camp, a distance of 11 miles, includes some of the best spawning areas to be found anywhere in the Willamette River system. It is estimated that the North Fork could accommodate a run of at least 20,000 chinook salmon. A 35-foot high lumber mill dam at the town of Westfir was equipped with a very poor fish ladder and was virtually impassable at the time of the survey. This dam, which was primarily responsible for the depletion of the former excellent run of spring chinooks into the North Fork, was washed out in a flood, and was replaced in 1948 with a new dam and an improved fishway meeting the requirements of the Oregon Fish and Game Commissions.

There was some lumber mill debris and domestic garbage and sewage in the lower 1.3 miles of the stream below the town of Westfir. However, this did not appear to be sufficient to interfere with fish. Above Christy Creek, approximately 14.3 miles above the mouth, there were numerous windfalls and log and debris jams resulting from logging operations. Some of these formed good resting pools, and none appeared to be total barriers. There were several high impassable falls above Skookum Creek, the terminus of the survey.

No salmon were seen, and it is not believed that any were able to pass the Westfir Dam in existence at that time. Trout were abundant in the middle and upper sections of the river, including some of large size.

There are a number of small tributaries entering the North Fork. Most of them are short, steep, turbulent streams draining the steep mountain sides, and are of no possible value to salmon.

25EE-(5)a. Christy Creek.--(July 11, 1938; Morton.) Enters the North Fork approximately 14.3 miles above the mouth. The stream is about 8 miles long, and flows through a heavily forested, mountainous area. Logging operations were in progress along the stream at the time of the survey. The lower 2 miles were surveyed up to a series of three 5-foot falls which were considered a barrier to salmon. The stream was about 40 feet wide, discharging 58 c.f.s., and the water temperature was 60° F. The gradient is steep throughout, with numerous cascades and a series of low falls 1½ miles above the mouth forming a barrier to fish at low water stages. The lower 1/2 mile was choked with logging debris at the time of observation. There is some suitable spawning area in the lower 1½ miles, and it was estimated that the stream might accommodate about 200 adult chinook salmon. No salmon were observed, and there is apparently no run into the stream at present. Rainbow trout were abundant.

25EE-(5)b. Fisher Creek.--(July 15, 1938; Morton) Enters the North Fork approximately 30 miles above the mouth and is about 7 miles long, of which the lower 2 miles were surveyed. The stream extends through a densely forested, mountainous area. The gradient is steep, with numerous

cascades, low falls, and log jams rendering most of the stream of little possible value to salmon. The average stream width was 20 feet, the discharge was 45 c.f.s., and the water temperature was 52° to 54° F. There is little suitable salmon spawning area, and no run into the stream. Fisher Creek is of significant value to trout, the dense marginal vegetation affording good protection.

25EE-(6) Salmon Creek.--(September 1, 1937, and July 12, 17, 1938; Hanavan, Baltzo, Kolloen, Morton, and Langton.) Enters the Middle Fork of the Willamette approximately 39 miles above the mouth. The stream is about 24 miles long, of which the lower 19 miles were surveyed. The lower 2 miles flows through a flat, partly cultivated valley, narrowing to a steep-walled canyon upstream as the course extends through the upper forest covered hills. Records of the U. S. Geological Survey taken at a gaging station about 3½ miles above the mouth show flows ranging from 100 c.f.s., to 3,260 c.f.s., for the water year 1944-45. The stream gradient is moderate, and there are extensive suitable salmon spawning areas.

A falls 10 feet in height located about 5 miles above the mouth forms a barrier to the migration of salmon. It is estimated that there is sufficient excellent spawning area below the falls to accommodate several thousand salmon; however, this spawning area is not being fully utilized at present. In connection with the operation of the Oregon State salmon hatchery located on Salmon Creek the stream is often racked about one mile above the mouth for the purpose of taking spring chinook eggs for artificial propagation. There is a much greater amount of potential spawning area above the falls. Numerous log jams in this section and a 5-foot high log dam and a 6-foot falls at the upper terminus of the survey near the ranger station 2 miles above Furnish Creek form additional barriers to fish migration.

There is a large resident trout population in the upper section of the river, which maintains a sport fishery of considerable value.

There are a number of small tributaries to upper Salmon Creek which are of little possible value to salmon, although of some value to small trout. Only two of these, Black Creek and Furnish Creek, were surveyed.

25EE-(6)a. Black Creek.--(July 17, 1938; Hanavan.) Enters Salmon Creek approximately 13½ miles above the mouth. The stream is about 12 miles long, of which the lower 7 miles were surveyed. It was 25-35 feet wide, with a steep gradient, and the water temperature was 50° F. Black Creek is a continuous series of cascades and low falls, with numerous log and brush jams. The stream bed is composed mainly of large rubble, and there is little suitable salmon spawning area. It is doubtful if salmon could ascend very far, and the stream is of little possible value except to resident trout.

25EE-(6)b. Furnish Creek.--(July 17, 1938; Langton.) Enters Salmon Creek approximately 17 miles above the mouth. The stream extends for about 6 miles to its head in a small, high mountain lake. The lower 3 miles were surveyed. It is similar in size and topographic features to Black Creek, and is of little possible value to salmon. A few small trout were observed.

25EE-(7). Salt Creek.--(August 28, September 2, 10, 1937; Baltzo and Kolloen.) Enters the Middle Fork of the Willamette approximately 41 miles above the mouth. The stream is about 25 miles long, of which the lower 19 miles were surveyed up to the impassable Salt Creek Falls.

The greater part of the stream course extends through flat or gently rolling valley bottom lands. The valley narrows upstream, forming a narrow steep-walled canyon about 1½ miles below Salt Creek Falls, and continuing steep and mountainous in the upper section to the stream source near the summit of the Cascade Range. Throughout most of the lower 11 miles up to the confluence of Eagle Creek the stream has been directed into a new straight channel parallel to the road.

The watershed is covered with a heavy growth of conifers, thus insuring a good sustained flow, with no extreme fluctuations. The discharge at the mouth was 133 c.f.s., and the flow just above the confluence with the South Fork, 13 miles upstream, was 81 c.f.s. The water temperature ranged from 49° to 54° F.

Salt Creek Falls, at the upper terminus of the survey, is 285 feet high and is a total barrier to fish. Several log jams in the lower section appeared to be passable with some difficulty.

The stream gradient is generally moderate below the falls, and there is a large amount of excellent spawning area and adequate resting pools. A total of 87 spring chinook spawners were found well distributed throughout the course up to the falls. Many more were undoubtedly present and hidden in pools well protected by dense marginal vegetation. The stream has a potential capacity of several thousand chinook spawners.

Trout fishing is only fair below the mouth of the South Fork because the stream in this section is in close proximity to the road and is intensively fished. Good trout fishing was reported in the upper section.

25EE-(7)a. Eagle Creek.--(August 31, 1937, July 14, 1938; Baltzo and Kolloen.) Enters Salt Creek approximately 11 miles above the mouth The stream is about 5 miles long, of which 0.8 mile was surveyed up to a series of impassable low falls and cascades. The discharge was 26 c.f.s. The gradient is steep, and there is little suitable salmon spawning area. Although of no importance to salmon, the stream is of some value to resident trout.

25EE-(7)b. South Fork.--(August 31, 1937, July 14, 1938; Baltzo and Kolloen.) Enters Salt Creek approximately 13 miles above the mouth. The stream is about 8 miles long, was discharging about 15 c.f.s., and the water temperature was 54° F. The stream is blocked at the mouth by a series of impassable falls, and is of no value to salmon. It is of some value to resident trout.

25EE-(8). Hills Creek.--(September 11, 1937; Baltzo and Kolloen.) Enters the Middle Fork of the Willamette approximately 43 miles above the mouth. The stream is about 15 miles long, of which the lower 2.7 miles up to Kitson Hot Springs were surveyed. The stream was 30-40 feet wide, discharging 20 c.f.s., and the temperature was 57° F. The gradient is moderate, and the stream contains good salmon spawning areas.

An abandoned sawmill diversion dam 10 feet high located 1½ miles above the mouth is a total barrier to the upstream passage of fish. it was estimated that there was sufficient suitable spawning area below the dam to accommodate several hundred spawning salmon, and a much larger amount of unavailable spawning area above. There is little potential spawning area in the 3-mile long box canyon immediately above Kitson Springs. Above the canyon the stream levels out, and there are excellent potential spawning areas.

A total of 23 spring chinook salmon spawners were seen below the impassable dam. It was reported by local residents that heavy runs formerly occurred, before construction of the dam. The stream is of considerable value to resident trout, and is intensively fished in the lower section. The upper section, accessible only by trail, supports a large trout population.

There are at least 10 small tributaries entering the Middle Fork of Willamette in the 9-mile section between Hills Creek and Buck Creek. None of these had flows greater than 3 c.f.s., and they were too small and steep to be of value to salmon.

25EE-(9). Buck Creek.--(July 10, 1938; Hanavan.) Enters the Middle Fork of Willamette River approximately 51 miles above the mouth. It is about 6 miles long, of which the lower 1/2 mile was surveyed up to an 8 foot high log jam and falls forming a total barrier to fish. The stream was about 18 feet wide, was discharging about 12 c.f.s., and the water temperature was 54° F. The gradient is very steep, and there is little suitable salmon spawning area. The stream is of some possible value to trout.

25EE-(10). Coal Creek.--(July 9, 1938; Langton.) Coal Creek is the only one of ten tributaries entering the Middle Fork of the Willamette in the 7-mile section above Buck Creek that is large enough to be of any importance to salmon. Coal Creek enters about 58 miles above the mouth. It is 9 miles long, of which the lower 2.6 miles were surveyed up to an

impassable 20-foot falls. The stream was about 20 feet wide and was discharging 30 c.f.s. The gradient is steep, and there is sufficient salmon spawning area below the falls to accommodate only about 350 fish. No salmon were seen or reported. A few small cutthroat trout were observed.

25EE-(11). Simpson Creek.--(July 10, 1938; Langton.) Enters the Middle Fork of Willamette approximately 60 miles above the mouth. The stream is about 6 miles long, of which the lower 1½ miles were surveyed. It was discharging about 15 c.f.s., and the temperature was 52° F. The gradient is steep, the stream being a succession of cascades and low falls, with numerous fallen logs. There is little spawning area, and the stream is of no value to salmon, and only of slight value to trout.

25EE-(12). Staley Creek.--(July 9, 1938; Morton.) Enters the Middle Fork of Willamette approximately 61 miles above the mouth. The stream is about 14 miles long, of which the lower 3.3 miles were surveyed up to an impassable 20 foot falls. It was about 30 feet wide, discharging 57 c.f.s., and the water temperature was 54° F. The stream course extends through a narrow valley with alternate flat bottom lands and deep, steep, bedrock gorges in which there are many large clear resting pools.

A log jam 1 mile above the mouth was considered impassable at low water. There are many smaller log and debris jams, falls, and cascades in the stream below the falls, including two wide bedrock aprons that may be barriers to fish at low water.

The stream contains some good salmon spawning areas, estimated sufficient to accommodate 400 salmon spawners below the falls. Good runs of spring chinook salmon were reported to formerly enter the stream. Staley Creek supports a good population of resident trout, especially in the upper section.

25EE-(13). Echo Creek.--(September 11, 1937; Hanavan and Lobell.) Enters the Middle Fork of Willamette approximately 63 miles above the mouth. The stream is about 5 miles long, was discharging about 12 c.f.s., and the temperature was 52° F. The gradient is steep, and spawning area is confined to the lower 100 yards. The stream is of no value to salmon.

25EE-(14). Swift Creek.--(July 9, 1938; Hanavan.) Enters the Middle Fork of Willamette approximately 65 miles above the mouth. The stream is about 9 miles long, of which the lower 3.3 miles were surveyed. The discharge was 42 c.f.s., and the water temperature was 40° F. In the lower 1½ miles the stream extends through a swampy valley containing many flood channels. Above this section the stream extends through steep-walled canyons, where there are numerous cascades

and low falls. More than half of the stream bed is composed of large rubble. There are some patches of suitable spawning area sufficient to accommodate about 400 chinook spawners. No salmon were seen or reported.

25EE-(15). Tumblebug Creek.—(July 8, 1938; Langton.) Enters the Middle Fork of Willamette approximately 67 miles above the mouth. The stream is about 7 miles long, of which the lower mile was surveyed. It was about 20 feet wide and discharging about 20 c.f.s. The stream course extends through a densely wooded canyon in a high, inaccessible, mountainous area. The stream flows over an impassable series of low falls, cascades, and log jams. A 10 foot high waterfall about 1/2 mile above the mouth, and a 6-foot falls through a log jam about 1 mile upstream were both impassable to fish. Tumblebug Creek is of no possible value to salmon.

25FF. Coast Fork, Willamette River.—(May 23 - June 20, 1938; Hanavan, Parkhurst, Morton, Wilding, and Langton.) The Coast Fork joins the Middle Fork to form the main Willamette River at a point 4 miles above the city of Eugene, Oregon, or approximately 189 miles above the mouth.

The river is approximately 50 miles long, of which the lower 42 miles were surveyed. It is formed in the hills of the Coast Range, and flows in a general northerly direction. The lower 30 miles extends through a wide, flat, cultivated valley, flanked by low, rolling hills. The remainder of the stream is in a narrow valley in timbered, mountainous country. In the lower section the river is 55-200 feet wide, and has a slight gradient. In the upper 20 miles the stream is less than 50 feet wide, and has a moderate to fairly steep gradient. U. S. Geological Survey gage readings taken at a station 18 miles above the mouth, and below Row River and the town of Cottage Grove show a maximum discharge of 30,600 c.f.s., on December 30, 1942, and a minimum discharge of 7 c.f.s. on July 21, 1938. The high water period normally occurs between January and April with flows up to 6,000 c.f.s. The summer low flows generally occur in August, and are usually not lower than 60 c.f.s. The flow is now regulated by the new Cottage Grove Dam 72 feet high, built by the U. S. Corps of Engineers in 1942 for flood control and other purposes.

The water temperature ranged from 60° - 65° F., in the lower 32 miles, and was 52° F., at Black Butte Fork, 43 miles upstream.

Twenty-two miles above the mouth and just above the town of Cottage Grove there is a concrete diversion dam 7 feet high for a flour mill. It has a poor fish ladder which was not operating at the time of observation. This dam was considered a barrier to fish except at high water. There is a 5-foot high dam located 1/2 mile farther upstream. A wide downstream apron renders this dam a barrier

except at high water. Approximately 28 miles above the mouth there is the new previously mentioned Federal flood control dam, which is a total barrier to fish. An old 8-foot high lumber mill dam was located 32 miles above the mouth. A flume from the mill pond was used to transport rough lumber to a planing mill 2 miles above Cottage Grove. At the time of the survey a poor fish ladder was entirely blocked by a stop log.

A 2-foot high wooden dam was located 34 miles above the mouth, and another old low mill dam was located 1½ miles farther upstream. Both were considered passable with some difficulty.

At the end of the survey, 3½ miles above Black Butte Creek, there was an old 7½-foot high splash dam with a 20-foot wide apron, rendering it impassable except at extreme flood stage.

Several low falls and cascades were found in the upper section of the river.

At the time of the survey there was quite heavy pollution of the river by domestic sewers and slaughter house wastes in the vicinity of Cottage Grove. The mid-section of the stream was badly polluted with sawmill waste; sawdust, bark, and slabs almost filling the channel in places. Effluent from a mercury mine was noted in the vicinity of the new Cottage Grove Dam.

25FF-(1). Bear Creek.--

25FF-(2). Lynx Hollow Creek.--These streams enter the Coast Fork 8 and 9 miles above the mouth. They were discharging about 4 c.f.s., on May 23, 1938, and are of no value to salmon.

25FF-(3). Gettings Creek.--Enters the Coast Fork about 15 miles above the mouth. It was discharging 15 c.f.s., on May 23, 1948, and was not surveyed.

25FF-(4). Row River.--(May 23-31, 1938; Kolloen, Parkhurst, and Langton.) Enters the Coast Fork approximately 19 miles above the mouth. The stream is 22 miles long, and was completely surveyed. U.S. Geological Survey records from a gaging station located about 5 miles above the mouth show a maximum flow of 20,000 c.f.s., on December 30, 1942, and a minimum flow of 14 c.f.s., on August 29 to September 2, 1940. The water temperature ranged from 54° to 62° F. The stream flow is now being regulated at the recently completed Dorena Dam, located 7½ miles above the mouth. This dam, 102 feet high, is a total barrier to fish.

There is a 6-foot falls 13 miles above the mouth that is passable to fish with difficulty.

Wildwood Falls, 25 feet high, is located 19 miles above the mouth, and is an impassable barrier.

No salmon or steelhead have been reported. Chubs and suckers were abundant in the lower section.

25FF-(4)a. Mosby Creek.--(June 13-16,1938; Parkhurst and Wilding.) Enters Row River 3½ miles above the mouth. The stream is about 18 miles long, of which the lower 14 miles were surveyed. The lower half of the course extends through a flat valley about 3 miles wide, where the stream is about 50 feet wide with a moderate gradient. The upper half of the course extends through a narrow mountain valley, where the stream has an average width of about 25 feet and an increasingly steep gradient with several low, passable falls.

U. S. Geological Survey records from a staff gage located about 3 miles above the mouth show a maximum flow of 7,760 c.f.s., on December 30, 1942, and a minimum flow of 3 c.f.s., August 15 to September 2, 1940. Flows of less than 15 c.f.s., often occur from August through October. The water temperature was 54° to 60° F.

There is a 3-foot high mill dam less than a mile above the mouth that is considered passable except at low water. There is an irrigation diversion dam 2 feet high located 3½ miles above the mouth that is a barrier to fish at low water. The diversion is about 1 c.f.s., and is unscreened.

Although there is a considerable amount of bedrock in some sections of the stream, there are many good spawning riffle areas and resting pools. However, much of the spawning area is not usable because of decreased flows and high water temperatures in the late summer months.

No salmon were seen or reported. Fair catches of cutthroat trout and a few whitefish were reported. Rough fish, such as chubs, suckers, and cottoids were abundant in the lower section.

25FF-(4)b. Harms Creek.--(Not surveyed) Enters Row River approximately 9 miles upstream. It is a small stream, discharging about 3 c.f.s., and is blocked by an impassable mill dam 18 feet high a short distance above the mouth.

25FF-(4)c. McCauley Creek.--(Not surveyed) Enters Row River approximately 11 miles above the mouth. A bedrock apron at the mouth rendered the stream impassable to the upstream migration of fish at the time of observation in May, 1938, although the discharge was about 10 c.f.s.

25FF-(4)d. Sharps Creek.--(May 30 - June 2, 1938; Parkhurst and Wilding.) Enters Row River approximately 18 miles above the mouth. The stream is 16 miles long, of which the lower 13½ miles were surveyed and extends through a narrow valley in a heavily wooded watershed. The

Figure 7.-- A shallow bedrock falls on Sharps Creek; a typical natural obstruction to fish at low water stages.

discharge at the mouth on June 1, 1938, was 77 c.f.s., and at a point 7.7 miles upstream was 46.4 c.f.s. Late summer flows of less than 10 c.f.s., are reported. The water temperature was 52° to 59° F. The gradient is fairly steep, with series of cascades and low falls. A log jam 6 miles above the mouth was considered a barrier to fish at low water. A cascade type falls 10 feet high located 10½ miles above the mouth is a barrier to the upstream passage of fish.

There are few large pools but many extensive spawning riffle areas below the falls, providing some potential spawning area. No salmon were seen or reported. A few cutthroat trout were reported.

There are several small tributaries to Sharps Creek, of which only Fairview Creek with a flow of 6 c.f.s., would be of any possible value to salmon. Table and Buck Creeks had flows of 2 c.f.s., and Walker and White Creeks were blocked by impassable falls. Martin Creek had a flow of 3 c.f.s., and was blocked by an impassable dam 1/4 mile upstream.

25FF-(4)e. Layng Creek.--(June 1, 1938; Hanavan and Langton.) Joins Frank Brice Creek to form Row River at a point approximately 22 miles above the mouth. The stream is about 11½ miles long of which the lower 5 miles were surveyed to an impassable 12-foot high domestic water supply dam. The stream had an average width of 30 feet, the discharge was 38 c.f.s., and the water temperature was 59° to 63° F.

The stream course extends through a narrow valley in a wooded, mountainous area. A large part of the watershed has been logged.

A 4-foot high dam for a swimming pool at the Rujada Ranger Station, 1½ miles above the mouth, might at times obstruct the passage of fish.

The gradient is fairly steep with numerous cascades and low falls. Over 50 percent of the stream bed is composed of bedrock and large rubble. No salmon were seen or reported. The stream does contain small numbers of resident rainbow and cutthroat trout. None of the tributaries were accessible for any great distance.

25FF-(4) f. Frank Brice Creek.--(June 2-3, 1938; Hanavan and Langton.) Joins Layng Creek to form Row River at a point approximately 22 miles above the mouth. The stream is about 16 miles long, of which the lower 8.3 miles were surveyed up to an impassable falls 25 feet high. The stream was 55 - 65 feet wide, the discharge was 132 c.f.s., and the water temperature was 50° to 52° F.

The stream flows through a narrow steep-walled canyon bordered by heavily forested mountains. Small scale logging operations were in progress.

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Devices
Willamette River	Falls	Approx. 40	Fishway
Johnson Creek	4 low dams	Low	None
	Log and brush dams		
Clackamas River	River Mill power dam	80	Fishway
	Cazadero power dam	60	Fishway
Eagle Creek	Falls	18	Fishway
Delph Creek	Hatchery dam	4	None
Tualatin River	Oswego dam	5	Fishway
	Lee Falls	12	None
Dairy Creek	Log pond dam	5	Fishway
Gales Creek	Log jams	5-8	None
	Water wheel		None
	Lumber mill dam	12	Fishway

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Devices
Scoggins Creek	Dam	4	None
	Dam	5	None
Molalla River	Gravel pit dam	Low	None
	Dam on side channel	11	None
	13 dams	Low	None
	2 cascades	6,10	None
Pudding River	Mill dam	4	None
Butte Creek	Lima dam	8	None
	Hartman dam	8	None
	Scotts Mills falls and dam	18	None
Abiqua Creek	Domestic water supply dam	16	Fishway
	Falls	100	None
Silver Creek	Mill dam	12	Fishway
	Dam	5	Fishways
	Log dam	Low	None
	2 unused old dams	Low	1 with fishway

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Devices
Silver Creek (Cont'd)	2 low falls	4-6	None
	Falls	146	None
	Falls	184	None
Drift Creek	Diversion dam	2	None
N. Fork, Drift Creek	Falls	35	None
Milk Creek	Mulino diversion dam	10	None
	Union Mills dam	13	None
Yamhill River	U. S. locks		Fishway
N.Fork, Yamhill River	Carlton mill dam	30	None
	Old mill dam		None
	Log jams		
Panther Creek	Mill dam		None
Willamina Creek	Power dam	16	Fishway
	Falls	10	None
	Falls	18	None
Rock Creek	3 log jams	5-8	None
	3 falls	6,6,9	None

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Devices
Agency Creek	2 beaver dams	4	None
	2 log jams	5-8	None
	3 falls	3-4	None
Mill Creek	Power diversion		None
	Irrigation diversions		None
North Santiam River	Jefferson ditch		None
	Sidney ditch		None
	Gardiner dam		Fishway
	Salem ditch		None
	Gardiner ditch		None
	West Stayton ditch		Screen
	Mill City dam	8	Fishways
	Log jam	15	None
	Detroit dam site	259	None
Little North Santiam River	Elkhorn Falls	25	None
Breitenbush River	Power dam	5	None
	Power dam	5	None

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Device
S. Fork, Breitenbush River	Falls	12	None
Marion Fork	Gatch Falls	40	None
South Santiam River	Diversion dam	4	Fishway
	Power dam	9	Fishway
	Series of falls	3-6	None
	Falls	20	None
Thomas Creek	Scio mill dam	6	Fishway
	Jordan power dam	15	Fishway
	Dam	3	None
	Dam	3	None
Crabtree Creek	Unused water wheel		None
	Log jam		None
	Irrigation diversion		None
	Lumber mill diversion		None
Roaring Creek	Dam	3	Fishway
Wiley Creek	Mill dam	30	Fishway

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Device
Quartzville Creek	Series of falls	6-20	None
Calapooya River	Brownsville mill dam	4	Fishway
	Finley mill dam	10	Fishway
	Log jams		None
Marys River	Lumber mill dam	4	None
Long Tom River	Fern Ridge dam	35	None
McKenzie River	Walterville Power canal		None
	Leaburgh Power dam	15	Fishways
	Tamolitsh Falls	35	None
Mohawk Creek	Falls	12	None
Camp Creek	Lumber mill dam	7	None
	Lumber mill dam	6	None
	Log jams		None
	Falls	5	None
S. Fork, Gate Creek	Falls	4	None
Blue River	Falls	9	None
S.Fork, McKenzie River	Log jams		None

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Device
E. Fork of S. Fork McKenzie	Log jam		None
	Series of falls		None
French Pete Creek	Series of falls	4-5	None
Augusta Creek	3 log jams	10-15	None
Horse Creek	Log jam		None
Separation Creek	Log jam		None
	Series of falls	Low	None
White Branch of Lost Creek	Series of falls	60	None
Deer Creek	Log jams		None
Middle Fork of Willamette R.	Springfield canal		None
	Meridian dam		None
	Log jams		None
Little Fall Creek	Dam	4	None
	Dam	25	None
	Log jams		None

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Device
Big Fall Creek	Falls	8	None
	Falls	8	None
	Falls	4	None
Winberry Creek	Falls	8	None
Portland Creek	Falls	8	None
	Falls	8	None
Lost Creek	Mill dam		None
N. Fork of Middle Fork, Willamette	Mill dam	35	Fishway
	Log jams		None
Christy Creek	3 falls	15	None
	Log jams		None
Fisher Creek	Log jams		None
Salmon Creek	Falls	10	None
	Log jams		None
	Dam	5	None
	Falls	6	None
Salt Creek	Log jams		None
	Falls	285	None

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Device
Eagle Creek	Series of falls		None
S. Fork, Salt Creek	Series of falls		None
Hills Creek	Mill dam	10	None
Buck Creek	Log jam and falls	8	None
Coal Creek	Falls	20	None
Staley Creek	Log jams		None
	Falls	20	None
Tumblebug Creek	Falls	10	None
	Falls	6	None
	Log jams		None
Coast Fork, Willamette River	Diversion dam	7	Fishway
	Diversion dam	5	None
	Cottage Grove Dam	72	None
	Mill dam	8	Fishway
	Splash dam	7½	None

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Existing Protective Device
Row River	Dorena dam	102	None
	Falls	6	None
	Wildwood Falls	25	None
Mosby Creek	Mill dam	3	None
	Diversion dam	2	None
Harms Creek	Mill dam	18	None
Sharps Creek	Log jam		None
	Falls	10	None
Layng Creek	Dam	4	None
	Water supply dam	12	None
Frank Brice Creek	Falls	25	None
Black Butte Creek	Falls	6	None
	Mill dam	8	None

The stream gradient is fairly steep, with numerous low falls and cascades. A falls 10 feet high located 2½ miles above the mouth was considered a barrier to the upstream passage of fish.

None of the six tributaries observed were considered large enough to warrant a detailed survey. A few cutthroat trout were the only fish seen or reported.

25FF-(5). Black Butte Creek.--(June 17, 1938; Hanavan.) Enters the Coast Fork approximately 38 miles above the mouth. The stream is about 6 miles long, and was surveyed for only 400 yards up to an old impassable 8-foot high mill dam. A falls about 6 feet high is located only 85 yards above the mouth, and is passable with difficulty. The discharge was about 15 c.f.s., but is much smaller in late summer. The stream bed was silted, and there was some pollution from a mercury mine. The stream was of no possible value to migratory fish.

PART III

ABOVE BONNEVILLE DAM (to but not including the Deschutes River)

Introduction

The Sub-area above Bonneville Dam includes portions of the Columbia Gorge and the east Cascade Mountain slope. In the foothill section the banks of the Columbia River slope gradually to the high hills and plateaus. There is little precipitation in this section except during the winter months. However, there are a number of small partially spring-fed streams rising in the hills that formerly had sustained flows, and that were reported to have formerly supported small runs of salmon and steelhead trout. At the present time the flows of nearly all of these streams are diverted for irrigation. Unless provision should be made for the release of small but sustained flows below the diversions these streams will continue to be of little value to salmon.

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        * (2) Wolf Run.

* Streams too small or too steep to warrant survey.

* B. Pine Hollow Creek.
* C. Larch Creek.
* D. Ramsey Creek.

The Survey

34. Eagle Creek.--(Inspected March 21, 1944; Nielson.) Enters the Columbia immediately above Bonneville Dam. The stream is about 11 miles long, of which the lower 2 miles were inspected up to an impassable falls over 100 feet high. Although there is spawning area for several hundred salmon, it is little used by the run of fall chinook which enters the stream because these fish are intercepted at hatchery racks of the Oregon Fish Commission located about 1/2 mile above the mouth. The eggs are taken to the Bonneville hatchery.

35. Ruckel Creek.--(Inspected March 21, 1944; Nielson.) This small stream entering the Columbia about 1 mile above Bonneville Dam is of little value to salmon because of an impassable falls 40 feet in height located less than 1/4 mile above the mouth.

36. Herman Creek.--(Inspected March 21, 1944; Nielson.) Enters the Columbia 5 miles above Bonneville Dam, is 7½ miles long, and is blocked by an impassable falls about 1 mile above the mouth. It was about 15 feet wide and had a flow of 20 c.f.s.

There is suitable spawning area for several hundred salmon below the falls, but this area is little used by the run of fall chinook salmon which enter the stream because these fish are intercepted at the mouth by hatchery racks of the Oregon Fish Commission. The eggs are hatched at the Ox Bow station on this stream and at the Bonneville hatchery.

37. Gorton Creek:
38. Lindsey Creek:
39. Warren Creek:
40. Starvation Creek:
41. Viento Creek:
42. Perham Creek:
43. Phelps Creek.--(Inspected March 22, 1944; Nielson.) These are all small streams entering the Columbia River in the 15 mile section between Herman Creek and Hood River. Some of them become dry during the summer, and all of them are blocked by impassable falls at points varying from 100 yards to 1/4 mile above their mouths. They are of no value to salmon.

44. Hood River.--(Inspected March 22, 1944; Nielson.) Enters the Columbia River at the City of Hood River, Oregon. The main stream is 11½ miles long to the confluence of the East and West Forks. The stream was

* Streams too small or too steep to warrant survey.

about 75 feet wide and discharging about 1,000 c.f.s., at high water stage. However, the discharge at the mouth from July through December is generally less than 50 c.f.s.

The Pacific Power and Light Company has a diversion dam 5 feet high located about 4 miles above the mouth. The effectiveness of a fishway at the east end is impaired by debris deposited near its lower end by a trash chute which parallels it. This condition could be corrected easily. About 450 c.f.s., is diverted at the west end of the dam through a pipe line to a power plant located 1/2 mile above the mouth. During low water periods this diversion carries almost the entire flow of the river, leaving the 3½-mile stream section from the dam to the powerhouse return dry or nearly so. The diversion is provided only with a trash rack, and should be screened to prevent the loss of fish. If possible, a flow sufficient for the passage of fish should be maintained at all times between the dam and the powerhouse return. The Oregon Fish Commission and Game Commission have recently successfully negotiated with the power company for an electric fish screen and a new fishway at the dam.

The Farmer's Irrigation Canal diverts a maximum of about 80 c.f.s., at a point 11 miles above the mouth and should be screened.

The gradient is moderate to fairly steep. Good resting pools are scarce, the stream bed is composed mainly of boulders and large rubble, and suitable spawning areas are scattered.

Hood River formerly supported large runs of fall chinook salmon and steelhead trout, the greater number of which spawned in the tributaries. Due largely to the effects of dams and diversions the chinook salmon run has been nearly exterminated, and the steelhead run has been greatly reduced.

This river system has good potential salmon production possibilities if the necessary stream improvements are made.

44A. Indian Creek.--(Not surveyed) Enters 1 mile above the mouth. It is a small stream, about 7 miles long, and is of little value to migratory fish because of irrigation use.

44B. Neal Creek.---(Inspected March 22, 1944; Nielson.) Enters Hood River 1/4 mile above the Pacific Power and Light Company Dam, is about 9 miles long, and had a flow of 60 c.f.s.

A concrete irrigation diversion dam 4 feet high is located 4 miles above the mouth, and is impassable to fish when flash boards are in place. The diversion amounted to about 30 c.f.s., but during low water periods practically the entire stream flow is diverted.

Suitable spawning area was found along the entire course of the stream, but in order for it to be utilized sufficient flow would have to be allowed below the dam for the passage of fish, a fishway constructed at the dam, and the diversion screened.

44C. Odell Creek.—
44D. Ditch Creek.—
44E. South Pine Creek.--These three small streams are of little possible value to migratory fish and were not surveyed.

44F. East Fork, Hood River.--(Inspected March 22, 1944; Nielson.) Joins the West Fork to form main Hood River. The stream is about 26 miles long, rising high on the slopes of Mt. Hood. The lower 6½ miles to the Eastside Irrigation Ditch was inspected. The stream was about 50 feet wide and discharging 450 c.f.s.

A concrete power dam of the Oregon Lumber Company, located 1½ miles above the mouth, is 38 feet high and was built in 1925. It has a 33 pool wooden fishway. The power diversion should be screened.

The Eastside Irrigation Ditch at a point 6½ miles above the mouth has a maximum capacity of 165 c.f.s. There is no dam, but the diversion should be screened.

In the stream section inspected there is a considerable amount of boulders, large rubble, and sand, suitable spawning area occurring only in small scattered patches. The upper section of the stream was not surveyed.

44F-(1). Middle Fork, Hood River.—(Inspected March 22, 1944; Nielson.) Enters the East Fork about 2 miles above the mouth. The stream is about 9 miles long to the confluence of the Clear and Eliot Branches, which rise in glaciers on the slopes of Mt. Hood. The stream was 60 feet wide and discharging about 400 c.f.s.

The Middle Fork irrigation diversion canal is located about 6 miles above the mouth, has a capacity of 70 c.f.s., and should be screened.

This stream has more good spawning area than the East Fork, and has definite potential value as a salmon producer if improvements are made on lower Hood River for the passage of fish.

44G. West Fork, Hood River.--(Inspected March 23, 1944; Nielson.) Joins the East Fork to form main Hood River 11½ miles above the mouth. The stream is 14 miles long to the confluence of Elk and McGee Creeks, which rise high on the slopes of Mt. Hood.

The lower 6 miles to the Dee Irrigation Canal was inspected. The stream was 40 feet wide and discharging about 300 c.f.s.

The famous Punchbowl Falls are located 1/2 mile above the mouth, where the stream drops about 15 feet into a large, deep, circular pool. It is reported that some steelhead are able to pass this falls at high water periods, and in former years considerable numbers of chinook salmon are said to have spawned above the falls. The pool below the falls was then a popular place for salmon anglers, who took large numbers of fish each year. No salmon have been seen above the falls in recent years, due in part to the reduction in flow because of diversions above, which has made the falls more difficult for fish to pass.

The Dee Irrigation Canal, located 6 miles above the mouth, has a capacity of 25 c.f.s., and should be screened.

The West Fork contains the best spawning area in the Hood River system, and could accommodate several thousand salmon and steelhead if the stream were made accessible by improvements in lower Hood River and the construction of fishway at Punchbowl Falls.

The upper 8 miles of the stream and its upper tributaries should be surveyed.

44G-(1). Dead Point Creek.--(Inspected March 23, 1944; Nielson.) A small stream entering the West Fork of Hood River immediately below Punchbowl Falls. It is blocked at the mouth by an impassable falls over 50 feet high, and is of no possible value to migratory fish.

44G-(2). Green Point Creek.--(Inspected March 23, 1944; Nielson.) Enters the West Fork about 1 mile above Punchbowl Falls. It is 6 miles long, 15 feet wide, and had a discharge of 25 c.f.s. The gradient is steep and there is little suitable spawning area.

45. Rock Creek.--
46. Mosier Creek.--
47. Rowena Dell Creek.--
48. Chenoweth Creek.—(Inspected March 23, 1944; Nielson.) These four small streams enter the Columbia River between Hood River and The Dalles, Oregon. They all carry little or no water during the summer. None of them are of value to salmon.

49. Mill Creek.--(Inspected March 24, 1944; Nielson.) Enters the Columbia River at The Dalles, Oregon. It is about 10 miles long to the confluence of its north and south forks. The stream was 12 feet wide and discharging about 20 c.f.s. Several small unscreened diversions were observed.

Although the stream contains suitable spawning area throughout, and is reported to have formerly supported small runs of salmon and steelhead it is now subject to extremely low flows during the summer and fall months, and is of little value to salmon.

TABLE OF OBSTRUCTIONS AND DIVERSIONS[1/]

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Diversion in c.f.s.	Existing Protective Devices	Recommendations
Eagle Creek	Hatchery racks, etc.				None
	Falls	100		None	None
Ruckel Creek	Falls	40		None	None
Herman Creek	Hatchery racks			None	None
	Falls	High		None	None
Hood River	Power dam	5	450 (often entire flow)	Fishway	Relocate trash chute; screen diversion; provide flow below dam.
	Farmers' irrigation canal		80	None	Screen
Neal Creek	Power dam	4	30 (Often entire flow)	None	See text
East Fork, Hood River	Oregon Lumber Co. dam	38	?	Fishway	Screen diversion
	Eastside irrigation ditch		165	None	Screen

1/ This list does not include minor cascades, low falls, log and brush jams, etc., that do not interfere with passage of migratory fish. The listed height of falls and dams is the approximate height that fish would have to jump to clear the obstruction at normal water levels. Small irrigation pumps are usually screened and are not listed in the table of diversions.

TABLE OF OBSTRUCTIONS AND DIVERSIONS

Name of Stream	Name or Type of Obstruction or Diversion	Height in feet	Diversion in c.f.s.	Existing Protective Devices	Recommendations
Middle Fork, Hood River	Irrigation canal		70	None	Screen
West Fork, Hood River	Punchbowl Falls	15		None	Fishway
	Dee Irrigation Canal		25	None	Screen
Doad Point Creek	Falls	50		None	None
Mill Creek	Irrigation diversions		small	None	None at present
Fifteenmile Creek	Falls	12		Fishway	Improve fishway
	Dam	10		None	Improve passage
	Cascade	6		None	Study-see text

The North and South Forks each contain some additional spawning area, but also are subject to low summer flows.

50. Threemile Creek.--(Inspected March 24, 1944; Nielson.) This small stream enters the Columbia about 2 miles above The Dalles, Oregon. Since it becomes completely dry during the summer and fall months it is of no value to salmon.

51. Fifteenmile Creek.--(Inspected March 24, 1944; Nielson.) Enters the Columbia 3 miles above The Dalles, Oregon. The stream is about 40 miles long, of which the lower 2½ miles was inspected. It was discharging 60 c.f.s., but the flow is reduced to less than 5 c.f.s., at the mouth during low water stages. This fluctuation in flow greatly limits the value of the stream to salmon.

There is a falls 12 feet high at a point 1/2 mile above the mouth. This fall is provided with a 5-step concrete fishway, but since the first jump is 3 feet high, it is difficult for salmon to ascend at low water stages.

An abandoned rock and masonry diversion dam 10 feet high is located 300 yards above the falls. This dam is generally passable around one end except at low-water stages, and could be improved.

There is a natural cascade about 1/4 mile above the dam that is a barrier at low water stages.

Although it was reported that a few chinook salmon enter this stream under favorable flow conditions it is of little present value to salmon. A few steelhead may ascend at high water stages and utilize some of the spawning area in the middle and upper sections.

The tributaries to this stream are also subject to the same unfavorable low water conditions in the summer and fall.

LITERATURE CITED

Craig, J. A. and Suomela, A. J.
1940 A Survey of the Sandy River and its tributaries, 1940, with reference to fish management. U. S. Fish and Wildlife Service Special Scientific Report No. 14. 20 pp. illus.

Gleeson, G. W., and Merryfield, F.
1936 Industrial and domestic wastes of the Willamette Valley. Eng. Exp. Sta., Ore. State Agri. College, Bull. Ser., No. 7, 65 pp.

Oregon State Planning Board
1937 A preliminary survey of industrial pollution of Oregon streams. Special Report to the Governor of the State of Oregon. 28 pp. Mimeo.

U. S. Bureau of Census
1940 Sixteenth census of the United States. Population, No. of Inhabitants. Vol. 1, Gov't. Print. Office, Washington, D.C.

U. S. Geological Survey
1930-1945 Surface water supply of the United States, Part 14, Pacific Slope Basins in Oregon and Lower Columbia River Basin. Yearly Reports.

Rich, W. H.
1948 A Survey of the Columbia River and its tributaries with special reference to the management of its fisheries resources. No. 1 Introduction. U. S. Fish and Wildlife Service Special Scientific Report No. 51. 26 pp. illus.

Fish Commission of Oregon
1948 Fish Commission Research Briefs, Vol. 1, No. 2.

Interior-Duplicating Section, Washington, D.C.